The Engineer

LONDON, FRIDAY, FEBRUARY 28, 1941.

PUBLIC NOTICES

ADMIRALTY

ROYAL CORPS OF NAVAL CONSTRUCTORS

A Competitive Examination for ENTRY into the ROYAL CORPS of NAVAL CONSTRUCTORS will be held in JULY next. Candidates must be not more than 24 years of age on the 1st October, 1941, and must by then have been engaged in practical Shipbuilding Work for at least 18 months. Graduates of the Universities are preferred.

Full particulars may be obtained upon application to the SECRETARY OF THE ADMIRALTY (C.E. BRANCH), BATH. Intending candidates must send to that address, before the 1st April, full particulars of their educational and technical training and of their practical experience.

PRIVATE STUDENTS OF NAVAL ARCHITECTURE.

In conjunction with the above a QUALIFYING EXAMINATION will be held for Private Students who desire to take the same course as that prescribed for Officers of the Royal Corps of Naval Constructors under training. Candidates' applications should reach the SECRETARY OF THE ADMIRALTY (C.E. BRANCH), BATH, before the 1st April. A fee of £50 per session is payable by Private Students taking this Course. 7146

CROWN AGENTS FOR THE COLONIES

COLONIAL GOVERNMENT APPOINTMENTS

Applications from qualified candidates are INVITED for the following POST :—

ASSISTANT ENGINEER REQUIRED for the Malayan Public Works Service for three years with possible permanency. Salary 400-25-800 dollars a month. (The Government rate of exchange is now 2s. 4d. to the dollar.) A children's allowance is payable to married officers with children. Free passages and, if married, subject to certain conditions, for wife and family also. Liberal leave on full salary. Candidates, age 23-26, must be Corporate Members of the Institution of Civil Engineers, or hold an Engineering Degree recognised as granting exemption from Sections A and B of the A.M.I.C.E. Examination; but Students of the Institution between the ages of 23 and 25 years who have passed the A.M.I.C.E. Examination are eligible for appointment. In either case, candidates should have had at least two years' practical experience on Engineering Works after taking their degree or completing articles, at least one year of which should have been spent in a Drawing Office.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, and mentioning this paper, to the CROWN AGENTS FOR THE COLONIES, 4, MILLBANK, LONDON, S.W.1, quoting M/9306. 7169

NORTHAMPTON POLYTECHNIC

ST. JOHN STREET, LONDON, E.C.1

LECTURER

Lecturer Required for Mechanical Engineering Subjects. The candidate appointed will be required to take classes up to B.Sc. standard in Heat Engines and to assist with other subjects according to qualifications. Particulars and application forms may be obtained from the Secretary. Applications should be submitted by 17th March, 1941.

(Signed) S. C. LAWS, M.A., M.Sc.,
Principal.
7175

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POWER DEPARTMENT

Applications are Invited for the POSITION of SHIFT CHARGE ENGINEER in the Company's Power Stations.

The duties will comprise the management of a shift operating modern power station equipment, including high-pressure water-tube boilers, turbo-alternators, E.H.T. switchgear, &c., and applicants, who should be not less than 33 years of age, must have had several years' responsible experience in such work, following a sound practical and technical training in mechanical and electrical engineering.

The commencing salary is £400 per annum, the appointment is subject to a three months' probationary period and the selected candidate will be required to pass a medical examination.

Applications, giving age and full particulars of education, engineering training and power station experience, should be addressed to I.C.I. (GENERAL CHEMICALS), Ltd., POWER DEPARTMENT, c/o CASTNER-KELLNER WORKS, WESTON POINT, RUNCORN, CHESHIRE, marked "S.C.E." 7182

EDWARD DURANT CECIL, deceased

PURSUANT TO THE TRUSTEE ACT, 1925 (Section 27)

Notice is Hereby Given that all CREDITORS and OTHER PERSONS HAVING ANY CLAIMS or DEMANDS AGAINST the ESTATE of EDWARD DURANT CECIL, late of "Gardd," Wollaston Road, Southbourne, Hants, Retired Civil Engineer, formerly of the following addresses :—

47, Whitworth Road, South Norwood, London, S.E.;

59, Selhurst Road, South Norwood, London, S.E.;

14, Jasmine Grove, Anerley, London, S.E.;

22, Rochester Road, Camden Town, London, N.W.;

who died on the 13th day of September, 1940, and whose will was proved in the Principal Probate Registry on the 20th day of December, 1940, by Harold Stanley Boulding, the sole Executor therein named, are HEREBY REQUIRED to SEND PARTICULARS THEREOF in writing to the undersigned on or before the 29th day of April, 1941, after which date the Executor will proceed to distribute the assets of the said deceased among the persons entitled thereto, having regard only to the claims or demands then notified, and will not be liable for the assets of the deceased or any part thereof so distributed to any persons of whose claims or demands he shall not then have had notice.

Dated this 17th day of February, 1941.

HOWE and RAKE,
of 22, Chancery Lane,
London, W.C.,
Solicitors for the said Executor.
7160

The Engineer

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IMPORTANT NOTICE

All correspondence dealing with Editorial, Advertising and Subscription Matters should be addressed to: 28, ESSEX STREET, STRAND, LONDON, W.C. 2

Remittances and Letters dealing with Accounts should be sent to:

"THE ENGINEER," Accounts Dept.,
c/o The Pitman Press,
Lower Bristol Road,
Bath, Somerset.

PUBLIC NOTICES

NOTTINGHAMSHIRE COUNTY COUNCIL

TEMPORARY ASSISTANT ENGINEER

Applications are Invited for the POST of ASSISTANT ENGINEER at the Ransom Sanatorium, near Mansfield, Notts. Applicants must have a thorough knowledge of the working of Lancashire Boilers with Automatic Stokers, High-speed Reciprocating Engines driving Alternators, Circulating Pumps, Calorifiers, Low-pressure Hot Water Heating Apparatus, Laundry and Kitchen Equipment. The successful applicant will be required to Take Charge of the Plant during the absence of the Chief Engineer.

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Application forms, together with conditions of appointment, may be obtained from me, and should be returned duly completed to the County Medical Officer, Shire Hall, Nottingham, not later than 7th March, 1941.

K. TWEEDALE MEABY,
Clerk of the County Council.

Shire Hall,
Nottingham,
19th February, 1941. 7153

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TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge, and co-operation is asked for.

IMPORTANT

Advertisers in Situations Open Column should make themselves acquainted with the terms of

STATUTORY RULES & ORDERS
1940 No. 877
RESTRICTION ON ENGAGEMENT ORDER

J. C. OLIVER, Ltd., Airedale Plant and Railway Works, Leeds, 10, sincerely THANK all APPLICANTS for the POSITION of ENGINEER, recently advertised, and beg to inform them that an APPOINTMENT has now been MADE. 7183 A

SITUATIONS OPEN

WANTED, Experienced STOREKEEPER for large General Engineering Works within easy reach of London; must be accustomed to up-to-date methods and capable of Controlling Extensive Stocks. State fully training, experience, present position, age, and salary required.—Address, 7163, The Engineer Office. 7163 A

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ASSISTANT to CHIEF ENGINEER of Asphalte company, with works London and provinces; must have Works Training and extensive Drawing-office Experience on Material Reducing and Handling Plant, Structures, &c.—Address, with particulars age, experience, and salary required, 7162, The Engineer Office. 7162 A

MACHINE SHOPS SUPERINTENDENT, with up-to-date knowledge of Heavy Machine Tools for General Forging Trade. Must have experience in shop management, supervising and fixing piecework prices, and be capable of arranging maximum output and production.—Address, 7127, The Engineer Office. 7127 A

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TWO CONSTRUCTIONAL STEELWORK DRAUGHTSMEN for East Midlands, thoroughly experienced in Designing and Detailing. Aged about 30 or over; wages £6-£7 p.w., according to experience.—Reply to EMPLOYMENT EXCHANGE, Scunthorpe. 7168 A

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CLASSIFIED ADVERTISEMENTS CLOSE FOR

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The Engineer

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"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER each alternate month. Next date, April 25th.

ADVERTISEMENTS.

The charges for Classified Advertisements are 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

Postal Address,
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Teleg. Address,
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SITUATIONS WANTED

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MECHANICAL ENGINEER (51) OPEN for APPOINTMENT. Lifelong experience in maintenance work and machine shop work, home and abroad.—Write, PERKS, 35, Thornsett Road, Sheffield, 7. P3057 B

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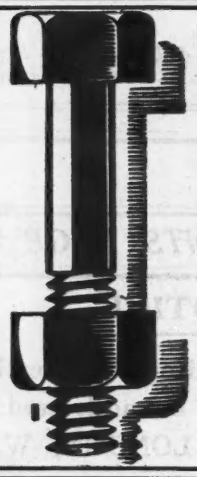

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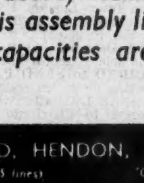

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A Seven-Day Journal

Maintenance of Motor Transport

IT is announced that the Ministers of Transport and Supply have decided to set up a committee to advise them on all questions relating to the maintenance of civil road transport and the repair of Service vehicles in civil establishments. A further duty of the newly appointed committee will be to advise the two Departments on the supply of motor vehicle parts and accessories, and the provision of maintenance and repair facilities for civilian road transport, including premises, equipment, and the provision of labour. The members of the Committee are as follows:—Mr. W. E. Rootes, President of the Society of Motor Manufacturers and Traders, who will be Chairman of the Committee; Mr. A. F. Palmer Philips, director of Vauxhall Motors, Ltd., representing car and light commercial vehicle manufacturing interests; Mr. R. F. Fryars, secretary of the Associated Equipment Company, Ltd., representing heavy commercial vehicle manufacturing interests; Mr. F. G. Smith, President of the Motor Agents' Association; Mr. George W. Lucas, managing director of Perrins Motor Garages (Southampton), Ltd., representing garage and repair interests; Mr. Albert Thomson, chairman and managing director of Brown Brothers, Ltd., representing the Motor Factors' Association; Major F. J. Chapple, general manager of the Bristol Tramways and Carriage Company, Ltd., representing public service vehicle operators; Mr. Frederick G. Bristow, Honorary Secretary of the British Road Federation, representing goods vehicle operators; and Mr. Benjamin King, chairman of Chrysler Motors Ltd., and Dodge Brothers (britain) Ltd., representing vehicle importers. The Secretary of the Committee, which held its first meeting on Friday, February 21st, is Mr. J. N. Henderson, of the Ministry of Transport.

The Late Sir Robert Hadfield's Bequests

THE publication of the will of the late Sir Robert Hadfield, F.R.S., the famous metallurgist and the head of Hadfields, Ltd., of Sheffield, who died on September 30th last, and an appreciation of whose work appeared in THE ENGINEER of October 11th, 1940, shows that his bequests will benefit many scientific and educational institutions. Sir Robert left the sum of £420,690 gross, with net personalty £184,029 (Estate Duty £60,092). His bequests included: His gold and other medals, diplomas, and certificates to the University of Sheffield, for any library or museum in connection with the Faculty of Metallurgy, and failing acceptance, to the Science Museum, South Kensington. Sir Robert's collection of alloy specimens, forming the record of his various papers to scientific and technical societies, are left to the Science Museum, South Kensington. The Royal Society receives the sum of £1000 for general research work. The sum of £250 is left to the Cutlers' Company, and a like sum to the Iron and Steel Institute for a prize in connection with the alloys of iron and steel, while £250 each is also left to the Benevolent Fund of the Institution of Civil Engineers, the Royal Infirmary (Sheffield), and the Sheffield Royal Hospital. To the Benevolent Fund of the Institution of Mechanical Engineers the sum of £100 is bequeathed. To his secretary, Mr. H. Hallatt, Sir Robert left the sum of £500, while to his executors he left the sum of £2000 to be applied in gifts or other payments to any person, society, or institution, who, in their opinion, had been omitted. The will includes a number of other legacies. The residue of Sir Robert's estate is left to his wife for life, and then four-fifths to the University of Sheffield for the furtherance of the objects of the Faculty of Metallurgy.

Accidents in Factories

THE report of the Chief Inspector of Factories Mr. W. A. Garrett, for 1939, on the occurrence of accidents in factories, was completed in October last, but on account of pressure of work on the staff it was not published until last week. In introducing the report, the Chief Inspector refers to the new order in working conditions which has grown up in industry following the new standards introduced in the 1937 Factory Act, and says that but for the war a still more marked advance would have been recorded. In 1939, the report states, there was an increase in fatal accidents of 17 per cent., and in non-fatal accidents of 7 per cent. A short analysis of accidents is given as follows:—Fatal accidents, six months, March to August, 1938, 457; March to August, 1939, 489, an increase of 32, or 7 per cent.; September, 1938, to February, 1939, 482; September, 1939, to February, 1940, 685, an increase of 203, or 42 per cent. The largest increase was caused by falls, often through the roofs, especially in the early days of introducing the black-out: Non-fatal accidents, six months, March to August, 1939, 85,319; March to August, 1939, 93,099, an increase of 7780, or 9 per cent.; September, 1938, to February, 1939, 92,563; September, 1939, to February, 1940, 104,571, an increase of 12,008, or 13 per cent. Reviewing the experience gained during the last war, Mr. Garrett points out that increased accidents were to be expected because of the following reasons:—Increase in the numbers employed and extension of the hours of work; rapid influx of new workers; general neglect of safety precautions in a patriotic endeavour to get things done quickly and lack of supervision of new workers due to scarcity of supervisory staff; shifting of working population from relatively safe to accident-producing industries; added risk due to fatigue and to working under mental distress; special work in connection with the black-out, and bringing into use old machines that may not have been protected in accordance with modern standards.

The Tin Research Institute

IN the course of his chairman's address, at the adjourned fourteenth annual general meeting of Southern Malayan Tin Dredging, Ltd., which took place in London on Friday, February 21st, Mr. C. V. Stephens paid a warm tribute to the work which is being carried on in the laboratories of the Tin Research Institute in connection with improvement and development of the uses of tin. During the past year, Mr. Stephens said, there had been many inquiries with regard to problems relating to the industrial uses of the metal, not a few of which were concerned with hot tinning. The Institute had now published a booklet, which for the first time, it was believed, laid down exact methods of working. The use of these methods should eliminate much of the trouble which has hitherto been experienced. In an experimental tin-plate making machine it had been demonstrated how modifications of current production methods could produce substantially better tin coatings. These experimental results and designs were now being tried out, he said, on full-scale plant by both British and American tin-plate makers. The electrodeposition of tin had been carefully studied and new and modernised plants had been organised on the basis of the newly recommended process. A new technique was being worked out for producing wrapping foils from base metal alloys, coated on both sides with tin, and considerable and permanent extensions of the use of such foils was expected in the food and wrapping industries. In the automobile and aircraft industries new tin-bearing metals of substantially increased strength were being tried out. The close contact made with the tin-using industries, not alone in Great Britain, but also in the British Empire and America, and the number of demands which were received by the Institute for assistance with problems arising in connection with the various uses of tin, were evidence, Mr. Stephens said, of the growing appreciation by the tin consuming industries of the value of the research programme which was being carried out by the Tin Research Institute.

The Chamber of Shipping Report

ON Wednesday, February 26th, the Annual Report of the Chamber of Shipping of the United Kingdom for 1940–41, which was presented at the annual meeting, held in London on Thursday, February 27th, was published. In it reference is made to the formation of the Ministry of Shipping and the various changes which have taken place in the office of Minister. It states that the present Minister, Mr. Ronald Cross, has brought to his office a sympathetic understanding of shipowners' problems which has facilitated the task of the Chamber. Once the policy of requisition had been determined, the shipping industry lent the fullest support to the Government in carrying out that policy in such a way as to secure the maximum benefit from our merchant marine. During the year covered by the Report, requisition, which had been applied to liner and tramp tonnage, was extended to coasting and short sea liner trades, and on January 1st last to tanker tonnage. The Chamber has also been concerned to assist the Ministry in its effort to speed up the turn round of ships, so as to secure the maximum use of available tonnage and to ensure the least possible delay in effecting repairs either at home or abroad, so that ships may be ready to put to sea again as quickly as possible. Throughout the year under review the Chamber has continued to urge that the protection of British and Allied shipping should be increased by every available means, both on the sea and in the air, and that every ship should be fully armed against all forms of attack. The Chamber has further urged that our shipping be recognised for what it is, one of the vital services upon which the fighting forces and the nation depend for safety and for victory, and that accordingly it should receive every possible consideration. The Report also refers to the higher cost of operating ships, which has been brought about by increases in wages of officers and crews, and the additional cost of stores and provisions. There have been considerable increases during the year in the cost of surveys and repairs, and a committee appointed by the Chamber has examined and reported on the problem of the increase in the cost of ship repairs over pre-war cost. Steps have now been taken with a view to a joint discussion of this problem with the ship repairing industry. With regard to the cost of building ships, it is pointed out that whereas a certain vessel would have cost £100,000 in 1938, its price had risen to £120,000 immediately before the war, and to £160,000 at the beginning of 1940. To-day no contract price can be obtained, so that no comparative figure is available.

The Loss of H.M.S. "Crispin"

ON Saturday, February 22nd, it was announced with regret by the Board of Admiralty that H.M.S. "Crispin," an armed auxiliary vessel of the Royal Navy, had been sunk. The "Crispin" was under the command of Lieut.-Commander Moloney, D.S.O., R.N.R., whom, we regret to have to record, was among those reported missing. The "Crispin" was in peacetime one of the later ships of the Booth Line fleet and was designed for carrying both passengers and cargo. She was built in 1935 at the Birkenhead yard of Cammell Laird and Co., Ltd., and was registered at Liverpool. The principal dimensions of the ship were as follows:—Length overall, about 450ft.; moulded breadth, 55ft. 6in.; and loaded draught, 25ft. 7½in. She was a single-screw ship and was propelled by a set of triple-expansion reciprocating engines with a Bauer-Wach exhaust steam turbine, having a designed output of about 3000 I.H.P. Steam was generated at a working pressure of about 220 lb. per square inch in three boilers of the Howden-Johnson type. The boilers were coal fired by hand. The "Crispin" was a pioneer ship, in that she was the first vessel to go to sea with Howden-Johnson boilers. She had a measurement of 5051 gross tons and a deadweight carrying capacity of 7870 tons, her designed service speed being about 13 knots.

Documentary Films to Promote Exports

AN interesting announcement with regard to the possible use of documentary films for promoting exports has been made by the Board of Trade. In co-operation with the Board of Trade Press Office, the British Council, which is supported by Treasury grant, is prepared to sponsor both production and showing of documentary films dealing with industries engaged in the export trade. For some years the Council has used films in its work of making British life and achievements better known and respected abroad. The Council recognises that it is appropriate to take as themes not only cultural ideals and traditions, but also the enterprise, technical progress and resources of British industry. It has recently sponsored films dealing with coal, shipbuilding, iron and steel, pottery and textiles. These films, of approximately 1000ft. to 1500ft. each in length, are made to the Council's order, under expert supervision, by the leading film producing companies. By the arrangement now made the Council would be willing to bear about four-fifths of the costs of making a film for an Export Group, or the industry it represents, if the Group agreed to contribute the remaining one-fifth. The Council would supervise production and bear all costs of distribution. Its technical advice would be freely available. Copies of films could be provided if Groups wished to arrange showings of their own at exhibitions, meetings and so on. The Council would not undertake to sponsor a film unless its Film Committee, upon which various Government Departments are represented, was satisfied that the subject matter was suitable for treatment in this way. No reference would be made to individual companies; the films would depict the activities of an industry. Treatment would aim at creating and holding the interest of general audiences and be guided by knowledge of tastes in countries where the films were to be shown. Any Export Group interested in this scheme is advised to get into touch with the Board of Trade Press Office, Millbank, London, S.W.1.

Aircraft Production in America

IN a broadcast address on Tuesday evening, February 25th, Sir Walter Citrine, the General Secretary of the Trades Union Congress, who has recently returned from a several months' tour in the United States and Canada, referred to the production of aircraft in America. After visiting many American aeroplane factories, Sir Walter said that he was in a position to state that there was a steady and constant improvement in American production. Whereas in July last there were only 78,000 men engaged in the United States aircraft industry, there were now over 250,000 men employed, and by June next that number would have risen to 500,000. His view was that the aircraft industry in America was expanding at an incredible rate, and factories were being built at an enormous speed. The increase in employment was reflected in many industries. When he arrived in America the number of unemployed was 8,000,000, but that figure had now been reduced to 5,000,000, and it was steadily falling. In the course of his address Sir Walter said that September next would be a decisive month in every way. By that time the American production added to the British would be definitely in excess of German production.

The Hong Kong Centenary and Applied Science

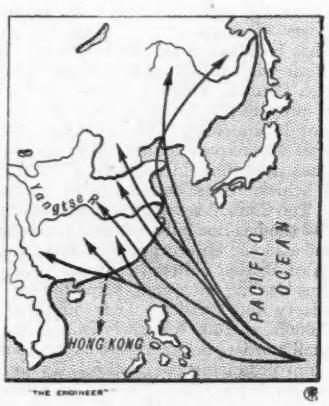
By Dr. C. A. MIDDLETON SMITH, M.Sc., M.I. Mech. E., LL.D.

No. IV

(*Continued from page 126, February 21st*)

The Public Works Department

THE engineering works carried out by the Hong Kong Government are of many different types. The Public Works Department not only is responsible for the sort of work done by a city surveyor's department in Britain, but there are harbour works and problems concerning the whole of the territory of the Colony, including a number of Chinese villages and some agricultural districts. These problems are complicated by considerations of defence, Chinese customs, &c. Thus, when it was decided to build the Shing Mun reservoir, in the leased territory, a Chinese village was in the valley that would be submerged when the reservoir was built. But the ancestors of the villagers had been there for many generations—possibly more than a thousand years—and the villagers refused, resolutely, to budge. They would not leave their homes and ancestral rice fields. A new and better lot of dwellings was built and other rice fields provided for them, but it took a great deal of diplomacy and expense to prevent bloodshed. The work of the Public Works Department officials is greatly complicated by old customs, and while the educated Chinese understand the benefits obtained by



TRACKS OF TYPHOONS

hygienic arrangements, the lower orders (the very large majority) regard them with suspicion. The Public Works Department officials learn to be patient and almost always manage to avoid friction, respecting Chinese customs as much as possible.

Public works, since about 1860, have been paid for out of revenue raised in the Colony until in later years a loan was floated, mainly to finance the new waterworks. Even so, the total public debt of the Colony is only about a million pounds sterling. The increase in revenue due to the improved water supply should be able to clear that debt in a reasonable time. It is doubtful if there is any other part of the Empire where a population of a million carry such a small public debt as £1 sterling per head with a good prospect of paying it off by extra sale of water. And remember, Hong Kong is a free port. There are no tariffs as there are for goods into China. It also obtains the benefit of Empire tariffs for cotton goods, rubber shoes, &c., to, say, South Africa or the West Indies, which advantage stimulates local industries.

Taking a very rough average we can say that, since about 1860, some 25 per cent. of the revenue of the Colony has been spent each year on public works. During the decade 1909–18 the cost of public works was on the average 2,293,762 dollars; during the decade 1919–28 it averaged 6,990,950 dollars; and during the decade 1929–38 it averaged just over 8,500,000 dollars per annum. During this last decade (1929–38) the total expenditure of the local government was averaging about 30,000,000 dollars.

These figures show how much both the total annual expenditure and the amount spent on public works increased during the last thirty years. When we remember that the total revenue of the Colony in 1887 was just about 2½ million dollars, and that it was about 36¾ million dollars in 1938, we realise how the Colony has developed in the last fifty years or so. Population, shipping, and trade figures show also this great and rapid increase in numbers.

The Director and Staff

The organisation of the Hong Kong Public Works Department is to-day, no doubt, very much the same as in other Crown Colonies. The Director is an engineer, and although in my time there was a suggestion that a member of the Administrative Department should be appointed to fill this post, it fortunately received but little support. The Director of the Public Works Department is a member of the Executive and Legislative Councils of the Colony. His maximum salary is £1800 a year, with pension, &c.

There were 148 European officers and 557 non-European officers on the staff of the Public Works Department when war broke out in 1939. A great deal of the work for the Public Works Department is done by Chinese contractors, but careful supervision of this work is essential. In recent years contractors have had the advantage of improved facilities for technical education. It has been of great value to the Colony and to China.

Engineers for the Public Works Department are appointed by the Crown Agents for the Colonies. During my residence in Hong Kong the conditions of service and, in consequence, the professional qualifications of engineers recruited for the Public Works Department improved considerably, but it cannot be said that the salaries of the engineers and other scientists in the Government service are satisfactory if we compare them with those paid to officers in the Administrative and Legal Departments of the Government.

The Public Works Department consists of a head office, for the Director and his personal assistants, and eleven sub-departments. These latter consist of (1) Architectural, (2) Buildings Ordinance, (3) Crown Lands and Surveys, (4) Drainage, (5) Electrical, (6) Port Development, (7) Roads and Transport, (8) Valuations and Resumptions, (9) Waterworks Construction, (10) Waterworks Maintenance, and (11) Accounts.

The architectural section deals with the design and maintenance of all (local) government buildings, the Armed Forces making independent arrangements. In recent years the Royal Engineers have made many plans for new barracks, &c., and large sums supplied by the Imperial Government have been spent on fortifications.

The local government architects and engineers have been responsible for a big building programme during the last twenty years. A large number of residences have been erected for Government officers. A new prison on the south side of the island must accommodate about a thousand prisoners. There are also residences there for European officers and warders. A very large general hospital, with air-conditioned operating theatres, was recently completed, and the latest expensive structure is the New Central Market, a four-storied building with a reinforced concrete frame. The Japanese invasion of South China caused large numbers of Chinese refugees to swarm into Hong Kong, and the local government built camps of timber construction with concrete floors to house them.

Chinese Contractors

The Building Ordinance Department is responsible for the general supervision of all plans for new buildings and alterations to existing structures. Before any work may be commenced in the Colony plans must be submitted to and approved by this Department. A staff of inspectors is employed in visiting works in progress to make sure that the provisions of local legislation are enforced. These regulations may, at first sight, seem to be severe, if examined by those familiar with building regulations in Britain, but they are the result of long experience with local conditions. Hong Kong buildings have to withstand the terrific force of typhoon winds, with a velocity at times up to or exceeding 165 m.p.h. The writer contributed to this journal* some notes on these terribly destructive and terrifying typhoons. Suffice to mention that in 1906 it was estimated that more than 10,000 casualties at sea around the Colony were caused by a bad typhoon; large liners in the harbour were thrown up on to the rocks ashore or sunk in the stream. This typhoon struck the Colony without any warning, and it had passed away within two hours. Nowadays wireless signals ensure ample time for preparation against typhoons, but even so they are dreaded. There are always disasters of some sort resulting from a bad typhoon; buildings suffer and landslides are common, but reinforced concrete for buildings and retaining walls has effected a great improvement. On the steep hillsides practically every structure is supported by a retaining wall, and on the flat area (nearly all of which is reclamation) piles are used.

The wiles of Chinese contractors make close supervision of work by Government very necessary. While there are reliable Chinese contractors, my own experience, when giving a general supervision during the erection of many buildings in the University grounds, made me realise that it is wise to suspect everything. During reinforced concrete construction, steel bars were removed, and the contractor was made to disintegrate a floor which he had filled in with concrete when I was not present. We found that 25 per cent. of the steel had been removed! One of my first efforts in Hong Kong was to establish arrangements for testing materials used locally or in China. Time after time we proved that Belgian steel (about 24 tons ultimate stress) had been substituted on site for the British steel (28 to 32 tons ultimate stress), and no doubt all of the frauds were not discovered. My endeavours to make 28 to 32-ton steel compulsory in Hong Kong failed, although Government officials always seemed to agree that the idea was good, but they never introduced the needed legislation.

TYPHOON DAMAGE AT HONG KONG: REINFORCED CONCRETE STRUCTURES SURVIVING

* THE ENGINEER, November 5th, 1937.

The cement made in the Colony, when tested, passed the British Standard tests, and so did all the Japanese cement tested—and we did numerous samples. But the Chinese contractors had to be watched when concrete was being mixed. There is in China a saying, "How can a dollar pass through my hand without leaving something behind." It is rather a waste of time to talk to the old-style contractor about the danger to human life if regulations for buildings are evaded. He thinks you are telling a yarn, and in any case he has so often got away with it, when taking a big risk, that he is convinced you make a fuss about nothing. And anyhow, human life is always precarious, and "what will be, will be." But Hong Kong magistrates fine heavily the contractors proved guilty of these deceptions. There have been uncomfortable moments when, in Chinese cities, it has been my fate to be in reinforced concrete structures.

The Building Ordinance Department works in close association with that section of the Government that deals with public health problems.

Crown Lands and Surveys

This sub-department not only conducts surveys for the local government, but deals with all land sales. Practically all of the land in the Colony is owned by the Government, except a number of rice fields in the leased territory. When the island was occupied a hundred years ago, owners of cultivated land were allowed to retain possession, but if at any time land was needed for a Government purpose, such as for a catchment area, fortifications, roads, &c., then the Government took possession and compensation was paid, the amount being fixed by arbitration.

WAREHOUSES DESTROYED BY TYPHOON IN 1922

It was fortunate for the new Colony that the first Governor was Sir Henry Pottinger (1841–44), for he seems to have taken steps to introduce regulations concerning the disposal of land on the island. He appointed a committee to investigate claims regarding "allotted locations of ground, and, finally, to define the locations already sold or otherwise granted, to fix the direction, breadth, &c., of the Queen's Road and all existing roads, to remove encroachments, to prevent reclamations in infringement of Her Majesty's royalties," and so forth. That was in March, 1842. Shortly afterwards the committee was given much wider powers—for town planning, in fact. Mr. James Matheson may perhaps be called the Founder of the Colony, for he had consistently advocated the creation of a British settlement in Hong Kong since 1827, when he published the first British newspaper in the Far East, the *Canton Register*. But Sir Henry Pottinger was the clever administrator who introduced the system of land sales. He insisted on town planning and he restricted speculation in land values.

When Jones or Wang Hing wishes to erect any structure on vacant land he shows the site to an authorised architect, who applies on his behalf to the Land Office, stating the sum his client is willing to spend on the new building. The area of land granted for the site is proportional to the cost of the building. The land may have been reserved for Government purposes, in which case another site is selected. If the site is free for sale, the procedure is as follows:—The architect is informed that "the upset price" of the land is, say, 3000 dollars, and the annual rent, say, 200 dollars. If the client agrees to these terms, advertisements inform the public that the Public Works Department will conduct a sale (auction) of such and such an area of land, situate, &c. The sale opens with the upset price, and often that ends the sale. But at times there have been exciting auctions. There was one on the south side of the island a few years ago, where the upset price was 5000 dollars and the final bid was 30,000 dollars. A Chinese soothsayer had pointed out that the site was lucky—water was visible from three out of the four sides. Building on the site must be completed in two or three years.

There have been other arrangements made for land reclaimed from the sea, if the reclamation blocks existing buildings from the sea front. There was a large scheme carried out rather more than fifty years ago, which was due to the initiative of Chater, and which increased the land area in the centre of Victoria by about 57 acres. The work was carried out by the Public Works Department, and careful costs were kept. Supposing some firm had property that, before the reclamation, had faced the sea, then when the work was finished that firm could claim the land between the old frontage and the new road along the praya, at a *pro rata* figure for the ratio of the area of the land mentioned above to the cost of reclamation of the total area of new land.

This system seems to have always been very profitable for the owners of marine lots. Thus we read in one dispatch that a marine lot which cost 40,000 dollars in 1883 was sold for 70,000 dollars in 1887, and that a *bona fide* offer of 150,000 dollars was refused in 1888. This last offer was at the rate of £3 per square foot, or more than £130,000 sterling per English acre.

Leases are now arranged for seventy-five years, but were formerly for ninety-nine years. In the first two or three years of the Colony some land was sold outright and there is freehold where cultivated land has been purchased from owners. But a very big annual revenue accrues from land sales and rents.

The Drainage Department has the problem of typhoon storm water and drainage to prevent breeding of mosquitoes, &c.; also sewage arrangements. When it is remembered that a fall of 26in. of rain in twenty-four hours has been recorded in Hong Kong, and the hillsides are steep, with big areas of flat reclaimed land at the base of hills, it will be realised that drainage is difficult.

In the urban districts the hill streams are sent swiftly into the sea down granite-lined nullahs, to prevent stagnant pools. Many miles in length of smaller drains—open mostly—have been made in other districts, with the same object, and oil is spread over stagnant pools. While the insects are not common in the urban districts, many residents use mosquito curtains at night. Nearly all Chinese houses have the primitive night-soil sewage system, and the soil is removed in the early morning to barges for disposal outside the Colony. But Chinese gardeners use it in spite of the dangers to health; it spreads enteric diseases.

Port Development

The Electrical Department is responsible for all Government installations, including the wireless stations. It advises Government on all the problems concerning electrical work in the Colony. Electric supply is from power stations owned by local companies.

The Port Development Department was for a time independent of the Public Works Department, but is now again a part of that organisation. It has been responsible for huge reclamations. In my time a very large hill, mostly solid granite, was thrown into the sea, forming many acres of new land on the island. Near Kowloon the big airport is situated on reclaimed land. An expensive and comprehensive scheme for port development was drawn up about twenty years ago by Sir Maurice FitzMaurice, and although much of it remains to be done, great improvements have been made. There are many vested interests, relics of the early days, that complicate harbour problems; leases for piers, ferries, &c., will soon be expiring. It seems probable that at no distant date some scheme on the lines of the Port of London Authority will be adopted, but there is likely to be local opposition from vested interests. The Harbour Master's Department deals with all shipping problems, but all engineering harbour works are done by the Public Works Department. Owing to the war in China, many activities for harbour improvements have been suspended, but when funds are available new wharves, piers, and many other works will be carried out by the Public Works Department to increase the facilities for shipping in the harbour.

Large motor ferries carry lorries, cars, and passengers at frequent intervals to and fro between the island and Kowloon. The Public Works Department built the piers, &c., and the Government leased the concession to run the ferries to a local company, which pays about 400,000 dollars per annum for the privilege. The ferries were built locally and are driven by British heavy oil engines.

The Port Development Department built two big typhoon shelters for small craft—junks, sampans, sailing boats, launches, &c. These shelters are formed by breakwaters consisting of the local granite. There is one alongside Victoria and the other by Kowloon. As soon as the first typhoon signal is run up on the Observatory, &c., the small craft in the harbour immediately set out for the shelters. At the back of the island, at Aberdeen, there is an inlet which provides a natural shelter. We have often seen the small craft running for this natural shelter hours before the first typhoon signal has gone up at the Observatory and other signal posts. The Chinese fisher folk seem to be able to tell of the coming typhoon, for the signal has always gone up after the sampans and junks have run into the Aberdeen shelter.

The Roads and Transport Department

The first roads to be made on the island and on the mainland were built by the sappers for military purposes. They were just about wide enough to allow marching by four men abreast. Indian troops stationed in the Colony had mules and mountain batteries. In the cities the local government took over the roads and nowadays maintains them, although in my time the military have cut new roads for defence purposes, which are maintained generally by the Public Works Department.

On my arrival in Hong Kong in 1912 it astounded me to find only three motor vehicles. These were permitted only on the praya—sea level road. Now there are roads all over the island and all round the leased territory; roads that astonish the visitor on account of their steep gradients, hair-pin bends, and excellent surfaces. The construction of roads over the steep hillsides of granite formation has not been an easy matter. There are many cuttings through the upper parts of the hills, and on the sides. In places the decomposed granite causes landslides, especially after typhoon rains.

The road round the island is about 22 miles long, and that round the leased territory 56 miles long. Under normal conditions this road in the leased territory connects with the road from the border to Canton city, about 90 miles inland. From Canton roads run to many parts of China. When peace returns to the Far East the motorist should be able to make tours from Hong Kong over some thousands of miles of roads in China. It can be said that the Hong Kong Public Works Department engineers have demonstrated that excellent highways can be built in sub-tropical South China, in spite of the torrential rains and the heat.

As the motorist covers these roads he has glimpses of most lovely scenery. Running up from Victoria and so to the beaches on the south side of the island, one rapidly rises to the gap on the central ridge of the island, and suddenly sees a number of small islands away to the south, a sight only surpassed by the view of the island and harbour at night from the road on the top of the hills beyond

Kowloon. The ships and the steep hillsides of the island show many thousands of twinkling lights, and these wonderful sights are made easy for residents and tourists because of the excellent roads.

The Valuations and Resumptions Department is included in the Public Works Department, but is not much concerned with engineering works. We will therefore only remind ourselves that a very big proportion of the revenue of the Colony is obtained as a result of the work done by this department. And we now come to consider what has proved to be perhaps the most difficult of local problems, that of providing an adequate water supply for the rapid increase in the population of the Colony.

(To be continued)

Efficiency Measurements of Rectifier Equipments

By J. C. READ, M.Sc.*

IT is well known that the only satisfactory way to determine efficiency is by direct measurement of the losses themselves. Input-output tests are unreliable under commercial conditions, even when carefully performed, and are in fact discouraged for that reason in all British Standard Specifications dealing with electrical machinery.†

The measurement of certain of the losses in rectifier equipments appeared at first to present a little difficulty, and this has occasionally led to methods of efficiency measurement being proposed which are either fundamentally incorrect or of unreliable accuracy.

Methods are now available, however, by which the losses in rectifier equipments can be directly measured by reasonably simple tests with very ample accuracy. The methods which should be used, and those which should not, may be of interest to users, who are concerned to know whether guarantees are fulfilled and whether the performances of different competing schemes are correctly compared.

Transformer Core Loss and Auxiliary Losses

The core loss in the main transformer (which is normally unaffected by rectifier operation, being simply a function of the A.C. supply voltage applied to the primary winding) and the losses in the various pieces of auxiliary apparatus, including the interphase transformer, if any, can all be individually determined from measurements in the usual ways, within limits of accuracy that are more than sufficient for the overall efficiency. These items, therefore, need no further comment.

The main transformer copper loss, however, and the arc loss in the rectifier itself, need more detailed consideration.

Main Transformer Copper Loss

By the copper loss we mean all loss in the transformer on load which is extra to the no-load (or "core") loss. The copper loss therefore comprises :

(1) The direct I^2R losses in the windings and leads, plus

(2) The transformer stray losses, *i.e.*, the eddy losses in windings, leads, clamping structures, tank, &c., which are produced by the leakage flux occurring on load. This stray loss may be subdivided into :

(2*a*) Stray loss due to fundamental current ; and

(2*b*) Stray loss due to harmonic currents.

With regard to the stray loss, it may be remarked that it is only necessary to make a reasonably close approximation, because the stray loss is always small compared with the total loss in the complete equipment. Even in the case of low-voltage, heavy-current equipments, whose stray loss tends to be above average, an approximate allowance for the stray loss is still justifiable, because it is precisely in such equipments that the transformer losses as a whole are small compared with the arc loss.

Standard Method.—The method now generally recognised for determining the main transformer copper loss is :

(1) The direct I^2R losses are calculated from the measured resistances of the windings and leads, as measured with D.C. and corrected to the standard reference temperature of 75 deg. Cent., and from the R.M.S. values of the currents in them.

(2*a*) A short-circuit test is applied to the transformer with all secondary terminals short circuited and with normal rated full-load current supplied to the primary. The stray loss in this test, *i.e.*, the difference between the input power measured in the test and that calculated from the resistances and the currents flowing during the test, is obviously equal to the fundamental stray loss when operating at full load with the rectifier, *i.e.*, this gives item (2*a*).

(2*b*) For both items (1) and (2*a*), the R.M.S. values of the currents in rectifier operation are taken as the simple values which would be obtained if the currents were exactly of rectangularly stepped wave forms, instead of the slightly lower R.M.S. values which actually occur due to the more rounded wave forms which exist in practice—that is, we take values of losses (1) and (2*a*) above, which are about 8 to 10 per cent. above the real values. This is done as a conventional allowance for the harmonic stray loss (2*b*), since it has been shown by de Blieux‡ that in rectifier transformers of normal design loss (2*b*) is approximately of this magnitude.

An alternative way to determine the copper loss in the main transformer is to calculate it from the inputs measured in certain special short-circuit tests, as shown in Fig. 1. This is

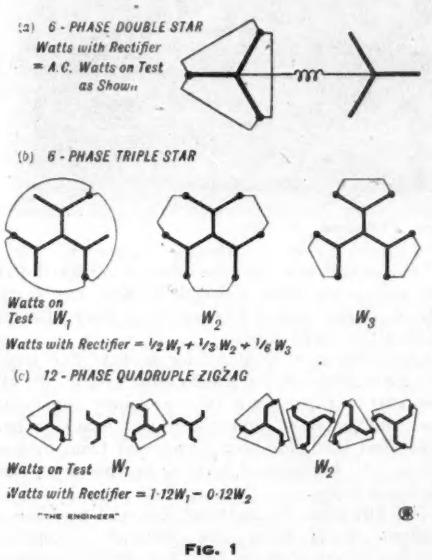

(a) 6 - PHASE DOUBLE STAR
Watts with Rectifier = A.C. Watts on Test as Shown
(b) 6 - PHASE TRIPLE STAR
Watts on Test W_1
W_2
W_3
Watts with Rectifier = $\frac{1}{2}W_1 + \frac{1}{3}W_2 + \frac{1}{6}W_3$
(c) 12 - PHASE QUADRUPLE ZIGZAG
Watts on Test W_1
W_2
Watts with Rectifier = $1{\cdot}12W_1 - 0{\cdot}12W_2$
"THE ENGINEER"

FIG. 1

simply a more roundabout way of performing the same calculations as are given above, and makes allowance for the stray loss in the same way, but with greater cost of testing. Consequently, the easier method described above is recommended in preference to that shown in Fig. 1.

Short-circuit Test on Complete Equipment.—There is another method that has been proposed as a means of measuring simultaneously the transformer copper loss, the arc loss in the rectifier, and the copper loss in any apparatus such as interphase transformers, anode reactors, &c., that may be in series with the main load circuit. According to this, the sum of these losses is taken as the input power measured when the rectifier equipment is operated at normal current and reduced supply voltage, with the D.C. side short circuited. Calculated corrections are made to subtract the transformer core loss at the low A.C. supply voltage in the test, and to correct the copper loss component of the loss to the standard reference temperature of 75 deg. Cent.

Unfortunately, this simple method, which makes no attempt at more than a rough approximation to the losses concerned, can in some cases be widely incorrect. The following is a comparison of the losses concerned, measured at full load on a 2500-kW rectifier equipment with six-phase, fork-connected transformer, first by this short-circuit method, and secondly by the more accurate methods here recommended :—

	kW.
Loss by short-circuit test on complete equipment	39·7
Loss by standard method of determining copper loss and by B.T.H. arc-loss wattmeter	51·94

Arc Loss

As the same design of rectifier can be used without modification in equipments of different ratings, it is unnecessary to measure the arc loss for every contract, but curves of arc drop can be determined once and for all for each design of rectifier, and used with the certainty that they will hold good without change so long as the design of the rectifier and the operating conditions, *e.g.*, temperature, remain substantially unaltered.

The arc drop varies with the temperature of the rectifier, and must therefore be measured at the normal operating temperature.

It is also necessary that the arc drop be measured with normal percentage reactance in the circuit—that is, it is not permissible to measure the arc drop on or near short circuit, since under that condition the average number of anodes sharing the total current in parallel would be increased, and the arc drop measured would consequently not be quite correct.

In order to show why the present accurate methods of measuring the arc drop have been evolved, it is desirable first to describe the earlier and less successful methods. The principal methods that have been proposed are :

(1) *D.C. Method.*—D.C. may be passed through the rectifier from one anode to cathode, and the drop between anode and cathode simply measured with a voltmeter. This method is inaccurate,

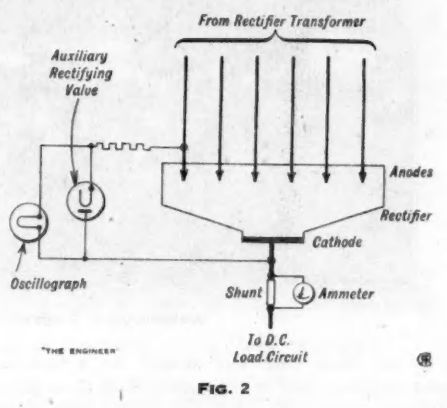


FIG. 2

even if additional current is fed in from the other anodes so as to bring the total cathode current to the correct value, since the voltage drop in the arc is not the same on steady current as on the normal pulsating anode current.

It is rather often assumed, even to-day, that the D.C. method of measuring arc drop is permissible in the case of single-anode rectifiers, such as ignitrons, excitrons, &c. It should be understood, therefore, that it is precisely in such single-anode rectifiers that the D.C. method may give very incorrect results and may show an apparent arc drop that is much below the true value.

(2) *Calorimetric Method.*—The loss may be calculated from the heat given up to the cooling medium. This method has hardly been attempted for any but water-cooled rectifiers, and even for these it is quite unpractical, since the heat capacity of the rectifier is so great that it is necessary to operate for many hours at strictly constant temperature and load, for each point on the arc drop curve. Moreover, large corrections have to be made for the heat carried away by natural radiation and convection, and the magnitude of these corrections can only be established by elaborate additional tests.

(3) *Oscillograph Method.*—A simple oscillogram may be taken of the voltage between the anode and cathode, and the arc drop measured in the oscillogram. This method is useless because at normal voltages the positive arc-drop voltage on the anode is so small compared with the negative voltage that the arc drop in the oscillogram is too small to measure with any accuracy.

(4) *Simple Wattmeter Method.*—A simple wattmeter, having its current coil in series with an

* D.C. Engineering Department, British Thomson-Houston Company, Ltd.

† For example, it is usual to require an increase of 0·75 per cent. in the efficiency tolerance when a test is by the input-output method, to cover the unreliability of such measurements.

‡ "Trans.," Am. I.E.E., 50, 1931, page 999.

anode and its potential coil connected between anode and cathode, will measure the arc loss corresponding to the current carried by the anode. But again, at normal operating voltage the high negative voltage on the anode makes it necessary to use a potential circuit of such high resistance that the wattmeter reading is too small for accuracy.

(5) *Oscillograph and Valve.*—A great advance on method (3) is given by connecting an auxiliary rectifying valve in parallel with the oscillograph element so as to by-pass the negative voltage away from the latter, *i.e.*, as Fig. 2. With this arrangement there is no error due to the addition of the auxiliary valve, if the latter is of a type which conducts practically no inverse current: the oscillogram obtained of the arc drop can be of ample scale; and the arc drop can thus be determined with very fair accuracy.

This method is, however, inferior, in the writer's opinion, to the arc-loss wattmeters (8) and (9) described below, for the following reasons :—

(i) The arc drop usually varies somewhat during the conducting period, and it is generally necessary to determine the mean value in the oscillogram by planimeter or calculation.

(ii) The anode current also is not constant during the conducting period, and hence, in cases where the variation of the arc drop is appreciable, it may be necessary to take a simultaneous oscillogram of the anode current, calculate point by point the product of volts × amperes, and from this calculate the mean watts loss per anode during the cycle.

(iii) In addition to possible errors in these processes, errors may also be present in the oscillogram, since the oscillograph itself is seldom a precision instrument as regards its deflection per ampere.

(6) *Wattmeter and Valve.*—This arrangement, shown in Fig. 3, is ideal in theory. The arc drop

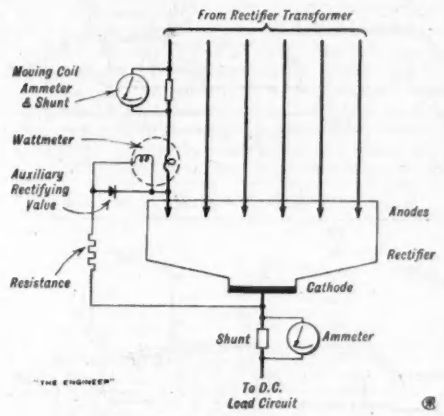


FIG. 3

is the quotient of the watts divided by the mean anode current. In practice, however, there are difficulties. Wattmeters for the full value of the anode current are not obtainable ; simple current transformers cannot be used, because the secondary current would not be a true replica of the anode current, due to saturation of the core by the D.C. component of the anode current; and schemes involving the use of an inductive shunt in place of a current transformer result in excessive voltage drop.

These difficulties have led to the development of the methods which will now be described.

(7) "*Indirect Wattmeter*" *Method.*§—In this arrangement, shown in Fig. 4, special double-primary current transformers are used so as to balance out the D.C. components of the anode currents ; the three wattmeters supplied from these current transformers measure the input power to the rectifier (plus the copper loss in the main transformer secondary, which has to be allowed for), and the arc loss is the difference between this corrected input and the output measured by the instruments in the D.C. load circuit.

This scheme has the disadvantage that, unless the test is performed at much reduced voltage —in which case the arc drop is not necessarily the same, and, indeed, the simpler methods (3) or (4) could be used—the arc loss is obtained as the small difference between two large quantities. In fact, this method appears to be in no way superior to an ordinary input-output test.

(8) *Lamm Arc-loss Wattmeter.*—A. U. Lamm‖ has described a modification of scheme (6) which appears to be very successful. This is shown in Fig. 5.

The magnetising current of the current transformer causes the current fed to the current coil of the wattmeter to be below the theoretical value ; but since the mean anode current as indicated by ammeter A is low by the same amount, the resultant error in arc-drop value, providing the arc drop is fairly constant, is small.

A second consequence of the magnetising current is that when the main anode current in the primary falls to zero, the secondary current changes, not to zero, but to a small negative value, and as the metal rectifier M will

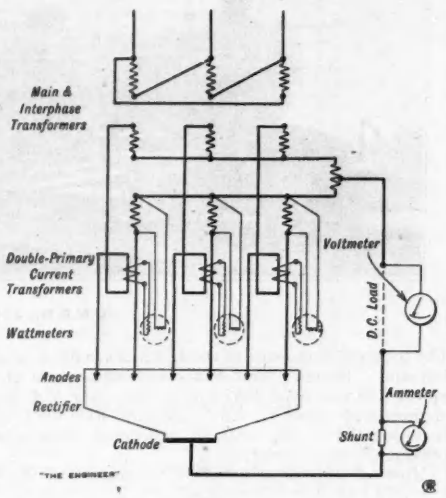


FIG. 4

not allow this to pass, the shunt resistance R_i has to be provided. The value of R_i must be fixed, within close limits, as a function of the magnetising reactance of the current transformer. Detailed calculations on this point, and an analysis of other errors present, are given in the original article.

With the actual arrangement used it is stated that the useful range of load currents for a given current transformer and resistance R_i is 3 : 1. Within this range it appears that good accuracy is obtained.

(9) *B.T.H. Arc-loss Wattmeter.*—The Research Laboratory of the B.T.H. Company has developed an arc-loss wattmeter in which the problem of supplying the current coil of the wattmeter is solved in a different way. This apparatus, the

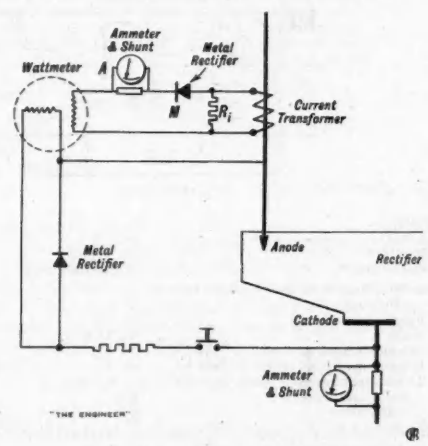


FIG. 5

connections of which are shown in Fig. 6, has been in regular use in the B.T.H. rectifier test for a number of years and has proved very successful. Its advantages are :

(i) Its accuracy is of a very high order ; in fact, only two simple, constant corrections, which can be determined easily by either calculation or test, have to be made.

(ii) It can be used over a wide range of currents, say, 10 : 1, without introducing appreciable error.

(iii) Its accuracy is unaffected by practical variations of voltage or current wave form.

Referring to Fig. 6, the current ratios of current transformer T and shunt S are made equal. The shunt thus injects a D.C. component of current into the secondary circuit, which neutralises the D.C. component in the current transformer primary. In consequence, the current i in the secondary circuit is a true replica of the primary current I. The shunt supplies the voltage to overcome the resistance in the secondary circuit, thus relieving the current transformer of this part of its burden, and the current transformer supplies the voltage necessary to overcome the reactance in the circuit. The magnetising reactance of the current transformer should be high compared with the reactance of the secondary circuit, and this requirement is easily satisfied as the current transformers—of which there is a range to suit rectifiers from the smallest to the largest ratings per anode—have mumetal cores.

With the connection shown, the wattmeter measures the power dissipated in the potential circuit in addition to the arc loss. Similarly, ammeter A measures the D.C. component of the current in the potential circuit as well as that in the main anode circuit. The requisite correc-

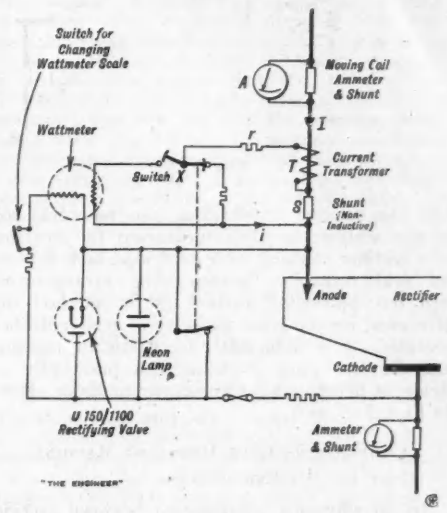


FIG 6

tions, which have to be deducted from the wattmeter readings and added to the ammeter readings, can be readily calculated, and they can be checked by observing the initial readings of the wattmeter and ammeter respectively when the main rectifier is operated without load on the D.C. side. These corrections are very small, so small that they can be taken as constant at any given voltage.

There are no other inherent errors. Temperature variations, notably in the current coil of the wattmeter, are eliminated by the switch X, by means of which the instrument is only in circuit momentarily while a reading is being taken. The resistance r, which has practically zero

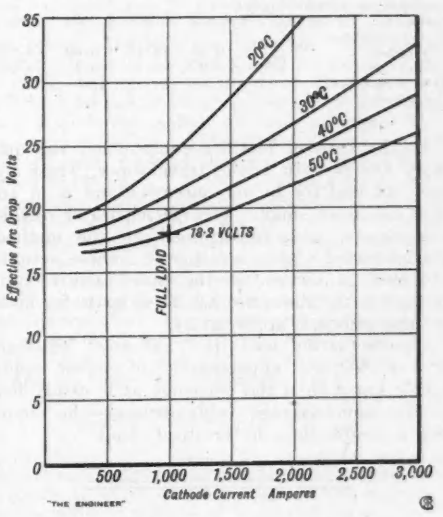


FIG. 7

resistance-temperature coefficient, also helps to hold the resistance of the current circuit constant. The wattmeter is magnetically shielded, and has proved to be unaffected by stray fields of the magnitudes met with in works testing. The slight unbalancing of the anode currents due to the connection of the instrument in one anode circuit is small enough within the normal range of load currents to be of no consequence.

Fig. 7 shows some arc-loss curves measured with the aid of the B.T.H. arc-loss wattmeter on a water-cooled steel tank rectifier.

It will readily be seen that accurate data such

§ *Brown Boveri Review*, Dec., 1931, page 369.
‖ Bulletin A.S.E., April 28th, 1939, page 229.

as that illustrated in Fig. 7, which can be quickly and easily obtained whenever a change of design is made, has great value in enabling both the efficiency and the reliability of rectifiers to be progressively improved.

Arc Loss of Grid-controlled Rectifiers.—Fig. 8 shows a modified arrangement which can be

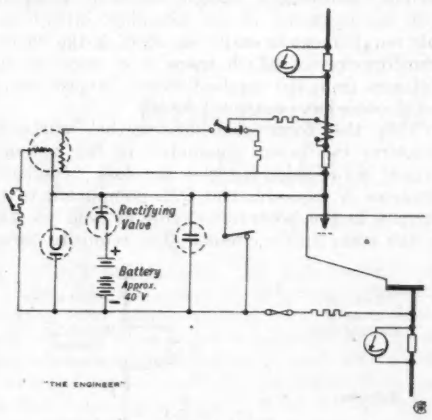


FIG. 8

used to prevent overloading the potential coil of the wattmeter when measuring the arc loss of a rectifier working with its firing much delayed by grid control. Corresponding arrangements can be applied to method (5) or method (8). However, for the great majority of grid-controlled rectifiers it is sufficiently accurate to measure the arc loss when working with practically no delay of firing, using the simpler methods shown in Figs. 2, 5, or 6.

COMPARISONS WITH ROTATING MACHINE EFFICIENCIES

In all efficiency comparisons between rectifier equipments and rotating machines it is necessary to make sure whether the rotating machine efficiency includes the stray loss, or whether it is an efficiency by "summation of measured losses," *i.e.*, exclusive of stray loss. According to B.S.S. 269—1927, the stray loss, *i.e.*, the loss in excess of the measured losses, for constant-speed machines rated on a load-plus-overload basis, is taken as follows :—

	Stray loss in percentage of rating.			
Load in terms of full load ...	2/4	3/4	4/4	5/4
D.C. motors and generators :				
Uncompensated	0·5%	0·75%	1·0%	1·25%
Compensated	0·25	0·375	0·5	0·625
Graded air-gap type... ...	0·625	0·625	0·625	0·625
Induction motors (polyphase)	0·25	0·375	0·5	0·625
Synchronous motors (polyphase)...	Nil	Nil	Nil	Nil
Rotary converters :				
50 cycles	0·30	0·45	0·60	0·75
25 cycles	0·2	0·3	0·4	0·5
Motor converters :				
50 cycles	0·5	0·75	1·0	1·25

In the case of rectifier equipments, the only stray loss is that in the transformer, which has been allowed for by measurement and is in any case relatively small. The efficiencies of rectifier equipments, when determined by the methods recommended above, are therefore those actually obtained in service at the same steady value of load (after allowance has been made for losses in connections, if appreciable).

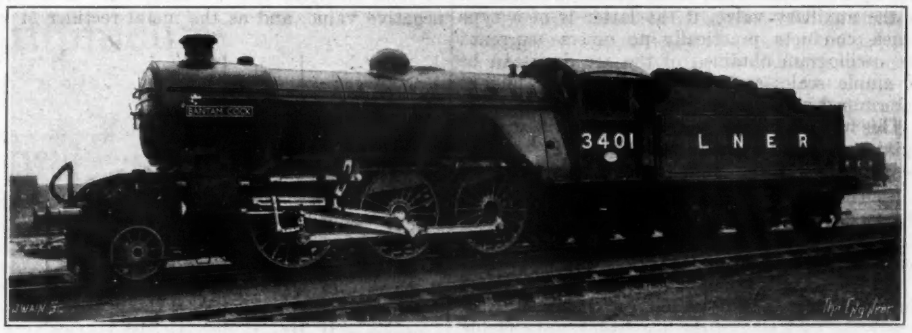
On fluctuating loads the "all-day" efficiency of any electrical apparatus is, of course, appreciably lower than the efficiency at a steady load of the same average value, because the copper loss is greater than on the steady load.

NON-STOP BUILDING.—Certain Government building contractors, states the Cement and Concrete Association, are introducing a new technique in winter-time building to counteract the limitations imposed by the black-out and weather conditions. Part of the programme on which these contractors are engaged includes urgent building work which is being carried out through the winter months. Large canvas screens are being used to protect the workmen from cold winds, retain the heat in the building, and enable construction to be carried on right through the hours of darkness. Hot water pipes are laid throughout the building to keep the atmosphere warm and help the rapid hardening of the concrete as it is placed. Steam jets are played on the aggregate to keep out the frost while the water is heated to maintain it at the correct temperature for concreting. This building technique, which is stated to be new on this side of the Atlantic, is eliminating stoppages resulting from bad weather and enables a 24-hour day to be worked.

L.N.E.R. New 2-6-2 Type Engine

FOLLOWING the success of the L.N.E.R. "Green Arrow" 2-6-2 type, V.2 class engine, the demand has arisen for a lighter engine of similar design suitable for working over sections of the line where the 22 tons axle load of the V.2 class engine is prohibited. To meet these conditions the first of two new 2-6-2 type V.4 class engines has recently been completed at Doncaster works to the designs of Sir Nigel Gresley.

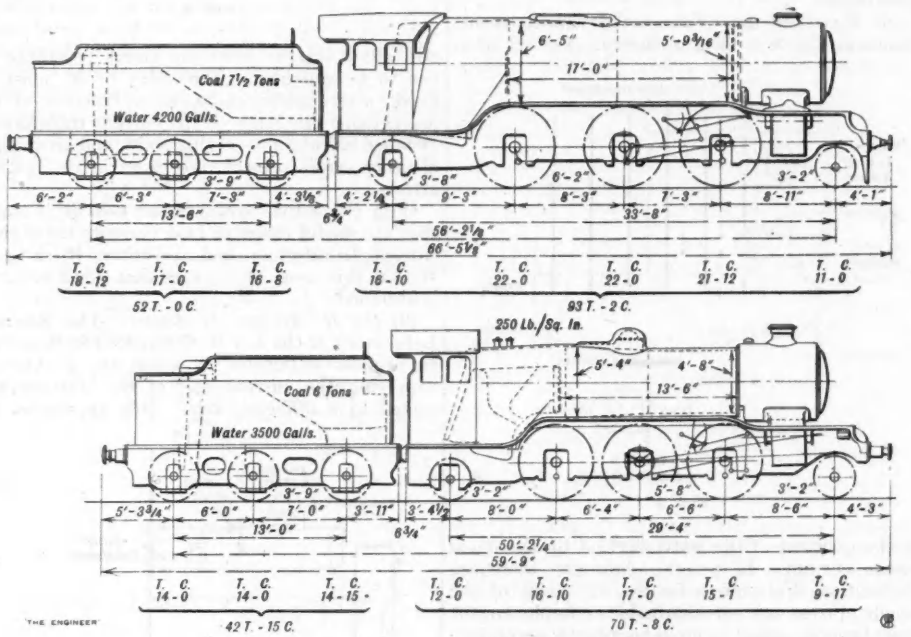
In the past the design of engines of medium weight and power to run on lines other than main lines has frequently been influenced by the length of existing turntables. The policy of the L.N.E. Railway has for some years been to replace the older small turntables by larger turntables of modern design, and in consequence it has been possible to introduce longer engines, embodying the features referred to above, with economical results.



L.N.E.R. 2-6-2 LOCOMOTIVE

The total route mileage of the L.N.E.R. is 6414 miles, but the "Pacific" and V.2 class engines are only allowed to run over 2752 miles. The new V.4 class engines with their 17 tons maximum axle load will be permitted to run over an additional 2248 miles, making a total of 5000 miles.

Most of the new L.N.E.R. engines embodying modern features built during the last twenty years have been of large size and power. The V.4 engine is of medium power and incorporates such features as high boiler pressure, high superheat, three cylinders, long valve travel and "Gresley" gear, which have been successfully developed in the larger engines.



Grate :	
Length on slope	4ft. 9 5/16 in.
Width	5ft. 11½in.
Grate area	28·5 square feet
Fire-box, height of crown above foundation ring :	
Front	5ft. 9in.
Back	4ft. 11 13/16 in.
Interior length at top	6ft. 6⅞in.
Interior width at boiler centre ...	4ft. 4½in.
Thickness of copper plate :	
Sides and back	½in.
Tube plate	9/16 in. and 1⅛in.
Boiler :	
Outside length of fire-box overall ...	9ft. 1⅛in.
Outside length of fire-box at bottom	5ft. 6in.
Outside width of fire-box at bottom	6ft. 9in.
Maximum diameter of barrel	5ft. 4in.
Thickness of barrel plates	19/32 in. and 17/32 in.
Thickness of wrapper plates	7/16 in.
Tubes, small :	
Material	Steel
Number	143
Diameter outside	1¾in.
Thickness	11 L.W.G.
Tubes, superheater flue :	
Number	22
Diameter outside	5½in.
Thickness	5/32 in.
Length between tube plates	13ft. 6in.
Heating surface :	
Fire-box	151·6 square feet
Tubes	884·3 square feet
Flues	408·2 square feet
Total evaporative heating surface...	1444·1 square feet
Superheater :	
Number of elements...	22
Diameter inside...	1·244in.
Heating surface...	355·8 square feet
Total heating surface	1799·9 square feet

Two Ross pop safety valves	3in. diameter
Working pressure	250 lb. per square inch
Axles :	Dia. / Length.
Journals, Pony	6½in. ... ... 9in.
Coupled	8½in. ... ... 9in.
Trailing	5½in. ... ... 10in.
Crank pins :	
Outside	5in. ... ... 5½in.
Inside	8½in. ... ... 6in.
Coupling pins :	
Leading	4½in. ... ... 3½in.
Driving	6in. ... ... 4½in.
Trailing	4in. ... ... 5in.
Springs :	
Pony, helical, 10 3/16 in. long free, 5½in. outside diameter, Timmis section	
Coupled wheels, laminated, 5in. wide, ½in. thick, 9 plates 3ft. 6in. centres	
Trailing wheels, laminated, 5in. wide, ⅝in. thick, 9 plates, 4ft. centres	
Brakes	Vacuum
Cylinders	Three, 15in. diameter by 26in. stroke
Motion—Type :	
Outside	Walschaerts
Inside	Gresley
Valves...	Piston
Diameter of valves	7in.
Maximum valve travel	6 1/16 in.
Steam lap :	
Outside cylinders	1⅛in.
Inside cylinder	1 11/16 in.
Exhaust lap	Nil
Cut-off in full gear	70 per cent.
Tractive effort at 85 per cent. boiler pressure	27,420 lb.
Total adhesive weight	108,752 lb.
Adhesive weight/tractive effort ...	3·96

PARTICULARS OF L.N.E.R. 2-6-2 ENGINE

In order that the V.4 class engine might conform to the limits imposed on secondary lines by the engineers, various methods were adopted to reduce weight, such as the use of 2 per cent. nickel steel for the boiler barrel and the extensive substitution of fabricated construction in place of steel castings for such parts as the drag-box, main frame stays, and the boiler supports. Weight has also been saved in the lighter construction of the footplate and its supporting angles and brackets. The resulting weight of the engine in working order is 70 tons 8 cwt., compared with 93 tons 2 cwt. of the V.2 class.

The three cylinders, 15in. diameter by 26in. stroke, together with the smokebox saddle, are a monobloc casting weighing 4½ tons. The piston heads and rods are an integral forging of class "C" steel and drive the centre pair of 5ft. 8in. diameter coupled wheels by nickel-chrome-molybdenum steel connecting-rods, 7ft. long. The coupling rods are of class "C" steel. The whole of the revolving and 40 per cent. of the reciprocating masses are balanced. The reciprocating balance of the inside engine is in the driving wheels and the revolving balance in the extended webs of the built-up crank axle. The reciprocating balance of the outside engine is equally distributed between the coupled wheels, together with the respective revolving balance. The journals of the coupled wheels are 8½in. diameter and 9in. long, lubricated by means of a Wakefield six-feed mechanical lubricator, and are provided with Armstrong oiler pads in removable trays. Piston valves, 7in. diameter, are fitted, the outside valves being actuated by Walschaerts valve gear, the suspension of the radius rod being arranged to accommodate the reversing shaft in the limited space available between the leading coupled and driving wheels. The inside valve is operated by the "Gresley" gear, which is now fitted to nearly 700 locomotives on the L.N.E. Railway.

The leading pony truck is of the standard L.N.E.R. double-swing link type, allowing a translation of 4½in. on either side of the centre line. The trailing carrying wheels are fitted with Cartazzi axle-boxes having slides with an inclination of 1 in 10. These arrangements, together with the short rigid wheel base, permit the engine to negotiate a 4-chain curve.

The boiler is of the same general design, but of smaller proportions, as that fitted to the "Pacific" and V.2 class engines. The maximum diameter of the barrel is 5ft. 4in., tapering to 4ft. 8in. diameter at the parallel front end course. The tapered course of the barrel is fitted with a steam collector immediately behind the dome, steam passing to the slide valve type regulator through a series of transverse slots, ½in. wide, in the barrel plate. The superheater header is of the Superheater Company's "AX" type with isolated saturated and superheated compartments and ball joint type elements. The working pressure of the boiler is 250 lb. per square inch, at 85 per cent. of which the tractive effort of the engine is 27,420 lb.

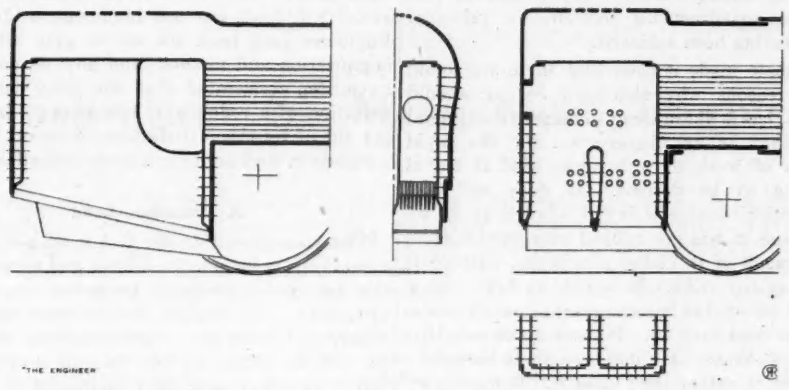
The first engine is fitted with a copper fire-box and copper stays. The second engine, which is to be put into traffic very shortly, has a steel fire-box, which is of completely welded construction except for the rivets passing through the foundation ring. This fire-box is fitted with a single Nicholson thermic siphon. Although the Nicholson thermic siphon has been used extensively on the Continent and in America, it will be the first to be fitted on a British railway. The two engines will afford a valuable means of carrying out comparative tests of the efficiency, maintenance cost and general reliability of steel and copper fire-boxes of the wide type.

In connection with the fitting of this siphon, it is interesting to note that a longitudinal midfeather was fitted to copper fire-boxes of engines designed by Mr. J. J. Cudworth for the South-Eastern Railway as far back as 1857—see sketch. As the midfeather extended to the fire-box back plate, two fire-holes were necessary, but the principle involved was the same as that of its modern counterpart.

A transverse midfeather across the centre of the fire-box was fitted on thirty 0–6–0 type engines built by Messrs. E. B. Wilson and Co. for the Great Northern Railway to Mr. Sturrock's design as early as 1851—see sketch. In 1860 twelve 2–2–2 type engines were built by Kitsons, Sharp Stewarts and Robert Stephensons to Mr. Sturrock's design, having longitudinal midfeathers similar to those used by Mr. Cudworth on the South-Eastern Railway. On other railways other forms—like Drummond's cross tubes on the L. and S.W. Railway—have been fitted from time to time.

The V.4 class engine is fitted with vacuum brake, two 21in. diameter cylinders operating blocks on the trailing side of each coupled wheel.

The tender is of especially light construction, the tank being completely welded; the drag-boxes and frame stays are also fabricated.



FIRE-BOXES OF S.E.R. ENGINE OF 1857 AND G.N.R. ENGINE OF 1851

L.N.E.R.—Comparison Between V.2 and V.4 Locomotive Boilers

	V.2.	V.4, with copper fire-box.	V.4, with one Nicholson siphon.
Heating surface :			
Fire-box	215 square feet	151·6 square feet	171·6 square feet
Superheater flue tubes	1004·5 (43 flues, 5½in. dia.)	408·2 (22 flues, 5½in. dia.)	408·2 (22 flues, 5½in. dia.)
Small tubes	1211·57 (121 tubes, 2¼in. dia.)	884·3 (143 tubes, 1¾in. dia.)	884·0 (143 tubes, 1¾in. dia.)
Total evaporative heating surface	2431·07 square feet	1444·1 square feet	1463·8 square feet
Superheater elements	679·67 square feet	355·8 square feet	354·4 square feet
Total heating surface	3110·74 square feet	1799·9 square feet	1818·2 square feet
Area through flues	519·397 square inches	265·73 square inches	265·73 square inches
Area through small tubes	380·133 square inches	255·6 square inches	255·6 square inches
Boiler pressure	220 lb. per square inch	250 lb. per square inch	
Cylinders (three)	18½in. dia. by 26in. stroke	15in. dia. by 26in. stroke	
Tractive power	33,730 lb.	27,420 lb.	
Adhesive weight	146,944 lb.	108,752 lb.	
Adhesive factor	4·3	3·96	
Grate area	41·25 square feet	28·7 square feet	

The general particulars of the engine and tender are shown in the table and diagram. Particulars of the V.2 engine are given for comparison. The designs for the V.4 class engine were prepared before the outbreak of war and the engines would have been built for service last summer if the materials had then been forthcoming.

"Pendulum"-Suspension Coaches*

ACCORDING to a recent announcement, three cars of the new "pendulum" or above-gravity-suspension type are soon to be tested in road service on the Santa Fe, Great Northern, and Burlington railways. Ideally, the above-gravity suspension hangs the car above its centre of gravity on an imaginary longitudinal axis which is allowed all necessary vertical and lateral movement against soft spring restraints. The wheels follow the rail irregularities while the body floats about a central position. In taking curves above superelevation speeds, the outward force acting on the centre of gravity causes the body of a conventional car to roll outward on the truck springs, adding to the discomfort of passengers. However, with the car supported above its centre of gravity, the outward curve force rolls the body in the direction for comfort, pendulum-wise. The original designs and the subsequent modifications adhere to a basic ideal car mounting in which the car is elastically supported at each end on a virtual, universal centre bearing on the longitudinal centre line above the centre of gravity of the car body. This virtual support permits sufficient universal swivel action of the truck relative to the car body to account for all operating conditions, and the springs together with the positioning linkage co-operate to achieve the desired vibration isolation. The actual car support, however, is at two points on either side of the car centre line, with a third attachment between the truck and the car body below the floor level. The desired motions are provided by flexure of the support system, suitably positioned and restrained. In the early models mechanical linkage and pivoted support arms provided the universal swivel action. In the present form, all motions between the truck and car body occur solely through elastic flexure, leading to an extremely simple lightweight truck and suspension system. The practicability of the above-gravity suspension system has been convincingly demonstrated in trial runs of a two-car experimental unit.

The Santa Fe, the Great Northern, and the Burlington railways each contracted for a de luxe type coach incorporating the above-gravity suspension system and skin-stressed lightweight body structure. The specifications require that the cars be built for unrestricted interchange service, although it is understood that one car with the new suspension system when coupled in with standard equipment is subject to end reactions which alter the performance of the spring system. Consequently, the three railways have agreed for a test period to keep the three cars together in road service in order that the middle car of the group can function in a representative manner.

* Abstract from *Electrical Engineering*, January, 1941.

Sixty Years Ago

THE CUNARD LINER "SERVIA"

ON March 1st, 1881, the Cunard liner "Servia" was launched from the Clydebank yard of J. and G. Thomson. Describing the proceedings in our issue of March 4th, we commented upon the rapidity with which the size of merchant vessels had increased within recent years. The "Arizona," of 5147 tons, had been considered a remarkably large ship only two or three years previously. She was, however, quickly followed by the "Orient," of 5386 tons; the "Austral," of 5500 tons, and the "Alaska," of 6250 tons. The "Servia" represented a big jump forward, her tonnage being 8500. Both as regarded her tonnage and her length—530ft.—she exceeded all other merchant vessels previously built, while as regarded engine power—10,500 I.H.P.—she surpassed anything afloat. From the naval architect's point of view, she was doubly interesting by reason of the fact that she was built of steel. She had a double bottom and was divided into nine water-tight compartments according to the Admiralty's requirements for war purposes. We noted particularly that all her frames and beams as well as her keel had been riveted by Twedall's hydraulic riveter. She had four decks and a promenade. In order to resist the impact of heavy seas all the deck-houses and fittings were of iron and were strongly riveted to the steel deck below. The ship was fitted with three masts which would carry "a good spread of canvas." The propelling machinery consisted of three-cylinder, compound surface condensing engines, steam being supplied by seven boilers, all made of steel. The propeller weighed 38 tons, and was made of Vickers steel. It was expected that the ship would have a speed of 17½ knots. . . . The extensive use of steel in the "Servia" represented a considerable degree of boldness on the part of her owners and builders. Steel was still a suspect material in many quarters. It was found to give perfect satisfaction in many cases, but at odd times it would fail through brittleness in an inexplicable manner. A very noticeable recent instance had been the failure under hydraulic test of the steel boilers of the Russian Imperial yacht "Livadia." The plates cracked during the test and the boilers were rebuilt in iron.

LIGHT SCRAP.—The crashing of aeroplanes and the salvage of the scrap has created problems of classification, the quality of which, a correspondent in *The Machinist* suggests, might be determined by chemical tests. Three solutions are recommended as sufficient to identify the light metal alloys when in scrap form: No. 1, 30 per cent. nitric acid solution in water; No. 2, 20 per cent. caustic soda solution, and No. 3, 5 per cent. hydrochloric acid solution in water. Solution No. 1 produces a positive reaction only with magnesium base alloys of the Elektron type. A drop of this solution placed on a perfectly clean surface of such alloy will produce a pronounced white colouration after a few minutes. This test is quite suitable for the identification of magnesium base alloy scrap. The alloys aluminium-silicon and aluminium-magnesium-silicon are indicated by a greyish-brown colouration with No. 2 solution. Pure aluminium is indicated when no etching reaction is obtained with Nos. 1 and 3 solutions. If a drop of No. 2 solution produces a black stain, the alloys containing copper (aluminium-copper and aluminium-copper-zinc) are indicated. If on wiping off the remaining caustic soda solution a drop of No. 3 solution removes the black stain, the scrap tested belongs to the group aluminium-copper-zinc.

The Engineer

FEBRUARY 28, 1941

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NOTICES TO READERS

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CHANGES OF ADDRESS

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BUSINESS MEN AND CIVIL SERVANTS

AT a venture, not two score of our readers have read the full report of the recent debate in the House of Lords on the Civil Service which has attracted so much public attention. We do not blame them. Unless they are interested in the gentle art of being rude gracefully and politely, and with all the decorum that is proper to their Lordships' House, there is nothing to gain by the careful study of a debate that was as short in sustained argument as it was long in the wind. It was opened by Lord Perry, chairman of Ford's, in a written and read speech sparkling with sarcasm and directed against the Civil Service. In it the noble Lord contrasted the efficiency of business men with the dilatoriness and fear of responsibility of permanent officials. Lord Cecil supported what he considered "an extraordinarily interesting and valuable contribution to our debates"; but he felt himself bound to point out to the noble Lord that in the last war "on the whole the record of business men in public administration was not good." On that we shall have a word or two to say. Lord Addison expressed the view "that the constitution and the habitual methods of work of our permanent Civil Service are not adapted to the rapid discharge of responsibilities called for in wartime," but he thought that we had not yet got the proper method of employing the experience and methods of business men in association with the Civil Service. Lord Barnby challenged Lord Cecil's criticism of business men in the Great War, and then the Lord Chancellor (Viscount Simon) fell upon Lord Perry and scarified him with forensic skill. He defended the permanent officials, contrasting their work with that of business men in terms which a skilful barrister for the defence would have had no difficulty in exhibiting, in fact, as a condemnation of Civil Service methods in business affairs. Lord Perry bowed to this blast and withdrew his motion, its principal purpose having been achieved.

The debate made it clear that there are sound political reasons why the Civil Service should be as it is, but it did nothing to remove the general opinion that as an organisation for the rapid execution of work of a business kind it leaves everything to be desired. It does not take responsibility because it is not allowed to do so, and because it will get rapped over the knuckles in Parliament if it makes a mistake. Hence it never runs any risks. It is not, as Lord Simon admitted, allowed to balance gains against losses as a business man may do. It must make sure that there *are* no losses. If there is a risk its business is to do nothing rather than incur it. It hems itself in behind an entanglement of protective devices to save its own skin, whatever may befall. Naturally, circumlocution and delay prevail and they are anathema to business men, like Lord Perry, who are used to making quick decisions and carrying them out promptly. If, and examples are not few, business men have failed in Government organisations, it is because the whole method is contrary to their way of life. They could not adapt themselves to Civil Service methods. They kicked against the pricks. They were bored by the unending exchange of notes and comments, by the dilatoriness and absence of the kind of system in which responsibility is decentralised, to which they are accustomed. But it is not a fact, quite the opposite, as Lord Cecil apparently believes, that business men were a failure as Government administrators during the last war. There are numerous examples to the contrary. Indeed, we say without hesitation that when the war had got into full swing it was the Departments controlled by men of experience brought in from the outside which did the best work and to whom the smoothness with which the supply of munitions ultimately ran was ultimately due. Mr. Lloyd George gave them power and they used it admirably. In the present war the same success may be seen. Business men—it would be invidious to name names—are being employed in many important posts, and it is to them that we owe in no small measure the acceleration in the rate of munitions and war material production which has astonished the world. Where the business man is allowed—that is an important condition—to override the permanent official, things can be done quickly. Unfortunately, that condition does not always prevail. In the realm of engineering our attention has been directed to many cases in which permanent officials without an iota of technical knowledge attempt to control technical men and settle technical questions. Needless to say, the result is foolishness. A junior engineer will know more about the technical side of a problem than a senior permanent official. The wise official will let him have his way; unfortunately, too many of them are unwise in the ways of business and too wise in the ways of the Service, too resolved to use their authority, and, since responsibility must be avoided, too careful in the provision of protective barricades.

When a country like Great Britain goes to war it has to employ all the devices and organisations which have served it during years of peace. It cannot change over night. It cannot suddenly throw overboard the methods to which it is accustomed. It cannot alter the traditional attitude of mind of permanent officials. A mountain of additional work falls upon them. Staffs have to be enlarged; new offices in new and strange quarters have to be provided. A small army of officials turns into a vast host. Small wonder that the Civil Service shows the strain and that such criticisms as those made by Lord Perry are justified. Gradually, as the war proceeds, improvement takes place. Men with special qualifications are engaged and by degrees the methods of permanent officialdom are overlaid by business methods. The pity is that this cannot be done more quickly; that the Cabinet does not recognise at once that in certain matters, and particularly technical matters, experts should be allowed not only to advise, but to act. Think what delays and expenditure might have been avoided if, when war was imminent, a Council of Engineers had been set up to give advice on organisation and method, and how output might have been accelerated if all the petty delays and irritation of a redundant bureaucracy had been got rid of by the introduction of sound business methods in engineering contracts and affairs.

A Canadian Lead

THE creation within the R.A.F. of a new Technical Corps to include the officers and men responsible for the exceedingly important engineering, armament, and signals duties, was announced nearly two years ago. Experience had shown, so the official statement ran, that in a modern air force, with its complicated equipment, it was not practicable to provide a body of officers capable of undertaking equally the duties of pilot and technician. Future entrants to the Corps would be university graduates, preferably those with honours degrees in engineering or natural science, or those who, in addition to having had experience in engineering works, had attained a degree of education approaching that level. Men without workshop experience would be given it on entry. Ability to fly as a pilot was not essential, though it would be natural that preference should be given to those who had already flown in University Air Squadrons or in the R.A.F. Volunteer Reserve.

While welcoming this step, we pointed to the analogy with the Corps of Royal Engineers, and stressed the vital need of attracting from the very start able and ambitious young engineers who in thus joining the Air Force would look to attain in due course to positions of honour and responsibility. To gain this desirable end, it was argued that no better start could be made than to appoint a Chief Engineer of high rank in the R.A.F. who would, by his personality and known achievement, act as a magnet to the type of men it was desired to attract. As we were glad to recognise at the time, the Royal Canadian Air Force had already moved in this direction in creating the position of Chief Aeronautical Engineer. The Canadian Government has now gone still further—the distinguished officer holding the post of Chief Aeronautical Engineer is to be a full member of the Canadian Air Council as "Member for Aeronautical Engineering." We are not aware of the reasons which led the Canadian Government to take this action, but it may be that the picture of a Council gathered around a table to consider plans to render even stronger the fighting efficiency of such a technical arm seemed somehow incomplete without there being present at least one member possessed of engineering education and experience. The first of the British nations to remove such an anomaly is Canada, and it is to be hoped that the senior partner will not fail to take note of what has been done. The bearings of this action by the senior Dominion will be closely watched by the Air Forces of the other Dominions in Australia and South Africa.

Since we last wrote on this subject, war has come, and although the immediate value of a Technical Corps to the Royal Air Force of to-day is easily seen, it is useful to consider, even in these days, its possible influence on the Air Force of the future. At present, almost the whole of the Government's scientific and technical staffs engaged on research and development in aeronautics is civilian. Will they in future years be drawn from the new Corps or will they continue civilian? In view of the highly specialised knowledge required of those engaged on research and the long period for which they are often required to explore a

single important problem, it will without doubt be best for a civilian staff to be used for research duties; but for the work of technical development, the application to practice of the results of that research, there is much to be said for using officers drawn from the new Corps. Any such considerable rearrangement as this might lead not unfittingly to research duties being entrusted to a civilian research department, such as the D.S.I.R., long accustomed in the nature of the case to the management of a research staff and able to provide wide opportunities for promotion. Such, it may be pointed out, is the plan already in force in America, as well as in Canada and in Australia.

In our previous reference to this subject we suggested that it would be wise for the authorities to consult the Councils of the Royal Aeronautical Society and of the other institutions concerned with aeronautical "engineering, armament, and signals." We are not aware how far this has been done, but to leave aside this simple precaution or to proceed on any scale to recruit men into the new Corps in advance of the appointment of its Chief, might well endanger the standing of the Corps from its birth. The engineering profession will support the new Corps the more heartily when it is seen that steps are being taken to safeguard in this way its future position and status.

Institution of Mechanical Engineers

AT a meeting of the Institution of Mechanical Engineers last Friday, February 21st, the annual report of the Council was presented and unanimously adopted. The following extract from the report reviews the activities of the Institution during 1940:—

Despite the necessary restrictions imposed by the war, a large measure of the ordinary peacetime functions of the Institution has been successfully maintained. The Institution building has been kept open throughout the year, and the library and reading room have been largely used, and in several respects the library showed that still greater use was being made of its services.

The number of applications for membership has steadily grown. The elections into all classes during the year brings the total to over 14,000, showing a net increase of 546 on the total at the end of 1939. Examinations were held as usual in April and October, and the number of candidates on each occasion approached normal figures. The April examinations were unique in that certain candidates were examined in His Majesty's ships at sea, and in the field in the actual theatre of war in France. The examinations in this country in October were held whilst air raids were in progress. It is of interest to record that the number of candidates following courses leading to the National Certificates and Diplomas in Mechanical Engineering shows but little sign of diminution.

With the necessary decrease in the number of meetings, both at the Institution and the branches, the Council felt it was of the greatest importance that publications should be maintained as regularly and adequately as circumstances permitted.

The Council have adopted the policy of holding one general meeting a month in the early afternoon for the presentation of technical papers and for the purpose of giving members the opportunity of gathering together. The meetings have been well attended, considering the circumstances, and the discussions of a high order. In the absence of the usual social functions, such as the annual dinner, informal luncheons were arranged to precede some of the general meetings. The specialised groups have also played their part in co-operating to secure adequate discussion of papers falling within their particular purview.

The war has necessarily reduced the Institution's research activities, and the work of one Committee in its exploratory stage and of another already at the end of its experimental work, has been postponed till hostilities cease. On the other hand, one Committee has continued its work almost as usual, and its second report is ready for publication, while another has finished its work and presented its final report. Subsidised individual researches in university laboratories are progressing satisfactorily.

Work in connection with the National Service Register has been continuous throughout the year, and the Institution has been instrumental in filling many important posts in the Services, in Government Departments, and in industry.

At the request of the Board of Education and the Service Departments a scheme has been arranged in co-operation with the Institutions of Civil Engineers and Electrical Engineers for technical instruction for engineers temporarily serving in His Majesty's Forces.

An informal scheme, which has the official approval of the Ministry of Labour and National Service, has been inaugurated to assist boys leaving secondary and public schools to fill in the period between leaving school and entering the Forces by special short training courses in engineering workshops. Engineering employers have responded very generously to the approach made to them to provide places, and advantage of the facilities provided has been taken by a good number of boys.

The Council appointed Mr. C. W. J. Taffs as assistant secretary of the Institution. Mr. Taffs joined the Institution staff in September, 1921. The Council regret that owing to ill-health Mr. Frank W. White, who had been a member of the Institution staff since 1903, was compelled to relinquish his appointment as chief clerk. Mr. White will be missed by a very large number of members with whom he came in contact, especially in connection with the Summer Meetings. Ten members of the staff are on war service, either with the Forces or on work of national importance.

When the Emergency Powers (Defence) Order for the compulsory registration of engineers in the Central Register of the Ministry of Labour and National Service came into force last July, the great majority of the members of the Institution who were available had already registered. A certain number of forms was received after the issue of the Order, but they related mainly to members who were in key positions, and consequently not available, or were actually in Government service. The majority of the members are, of course, directly engaged on armament work in private firms, but it is of interest to note that at least 16 per cent. are either serving in His Majesty's Forces or in Government Departments.

At the meeting itself, the President opened proceedings by announcing with regret the deaths of several members, including Dr. Hele-Shaw (a Past-President and Hon. Life Member), Professor Haigh, and Mr. James Brown, and asked members to stand for a few moments in respect to their memory. It was then announced that Sir John Thornycroft had been elected an Hon. Life Member. The President next proposed the adoption of the annual report of the Council, and when that business had been disposed of called upon Major Gregson to make an appeal on behalf of the Benevolent Fund.

The secretary announced the election by ballot of the following members of Council:—Mr. W. A. Stanier, President; Mr. H. L. Guy and Professor Andrew Robertson, Vice-Presidents; Mr. O. V. S. Bulleid, Wing Commander T. R. Cave-Browne-Cave, C. Hinton, Engineer Vice-Admiral Sir George Preece, Professor Dempster Smith, Mr. W. Mitchell (members) and Mr. W. H. Evans (associate member).

Mr. Asa Binns, the retiring President, then asked Mr. Stanier to occupy the presidential chair, and pointed out that he was the latest of a great succession of locomotive engineers who had occupied it, beginning with George Stephenson, the founder of the Institution, and having as representatives in the last ten years Lieut.-Colonel Kitson-Clark and Sir Nigel Gresley. Mr. Stanier in taking the chair said that he hoped the work of the Institution would go on increasing and that he would endeavour to follow the example of his predecessors. Mr. L. St. L. Pendred and Dr. Dorey then proposed and seconded a vote of thanks to the retiring President, which was accorded with acclamation. Mr. Asa Binns, in reply, paid a tribute to the untiring service of the Institution staff.

A paper, entitled "The Mechanical Requirements of the Royal National Lifeboat Institution," was presented by Lieut.-Colonel P. H. Johnson, an abstract of which is reprinted on another page. It led to a lively discussion of the requirements for carrying loads over loose or unstable surfaces, in which the importance of low ground pressures and the desirability of preventing the breaking up of the surface was brought out. Suggestions were made as to possible new uses for the girder track described in the paper.

Obituary

SIR ALLAN SMITH

MANY engineering employers will learn with regret of the death, on Friday of last week, at his home in Hampstead, of Sir Allan Smith, who for many years was the Chairman of the Management Board of the Engineering and Allied Employers' National Federation. Sir Allan was a graduate of Glasgow University, and after getting his M.A. and leaving the University qualified as a solicitor. Quite early in his career he became professionally associated with the Engineering and Allied Employers' National Federation. During the next quarter of a century he made his mark in industrial negotiations and occupied positions of increasing importance in the Federation. After the outbreak of the last war in 1914 he took a leading part in accelerating the output of shells and fuses, and he it was who negotiated with the engineering trade unions the Shell and Fuses Agreement, which was instrumental in increasing the output of munitions. He was appointed by Lord Kitchener, who at that time was Secretary of State for War, to be a member of the War Office Armaments Output Committee, and not long after receiving that appointment he was further nominated as a member of over thirty Government Committees and Commissions which were set up by the Admiralty, the War Office and the Ministries of Munitions, Reconstruction and Labour. During very many months Allan Smith devoted almost all his time, voluntarily, to the prosecution of the war in the service of the Government. For his many services he was created K.B.E. in 1918. In the following year he entered Parliament and was the Unionist Member for South Croydon until 1923. In the previous year, 1922, there was a serious dispute in the engineering industry, which was concerned with the freedom of management, and which caused the Employers' Federation to declare a lockout. Alongside that memorable dispute with the engineering trade unions were many agreements which Sir Allan Smith negotiated. In 1924 it was he who provided the industry with new facts for the settlement of wages claims, by preparing for the first time information concerning selling prices and production costs of engineering manufactures, which were applicable to the industry as a whole. At a later date that information was added to and in 1927 it was issued by the Federation in a pamphlet entitled "Thirty Years of Conciliation." Sir Allan continued in office as Chairman of the Management Board until on medical grounds he decided to retire in 1934. He will long be remembered by both masters and men as a man of exceptionally strong character. In his numerous addresses to trade unions he was straightforward to the point of bluntness. He rarely sought to conciliate Labour by smooth words, but relied on its acceptance of facts placed before it with masterly clearness. He gained the respect of the workers as a stalwart, but scrupulously clean, fighter. There can be no doubt that by his logical method of handling disputed questions he did an incalculable service both to labour and to employers. By removing obscurities he paved the way to better mutual understanding and the peace that resulted from it.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

EQUALITY OF OPPORTUNITY

SIR,—Most people will agree with the bulk of your remarks in your article on page 114 of THE ENGINEER for February 14th about "Equality of Opportunity."

In this connection the letter on "Engineers and the Future," published in the same issue, has a bearing. It appears to be possible for engineers to get so far, when it is assumed they have reached the highest rank which engineers should attain.

In your article you say "relationship does count," &c. One agrees that as long as the job is one where

brains and hard work are required, the able man will rise to the top and the relation may (but not always) find himself lagging in the rear. It often happens that the able man ultimately finds himself in the position of head engineer or works manager, but he also finds that by some process the less able relation has managed to get on the board of directors. Similarly, the chief mechanical engineer of a railway company also finds that he is under the control of a very large conglomeration of directors, many of them rather ancient, and quite a lot of them with very sketchy knowledge of railway procedure.

Personally, I shall be disinclined to believe in the equality of opportunity until I can see more chief engineers given a seat on the board of directors, and until I can see engineers taking a much larger part in the organisation of world affairs than is the case at present. I have heard many so-called business men boast that they can "always hire an engineer or chemist." No one has ever discovered what mysterious gift a business man has to have to put him in the superior position whereby he can sit on the board of directors and hire technicians, and until this mystery is cleared up equality of opportunity seems to have a string tied on to it.

February 17th. BRUMMAGEM.

ENGINEERS AND THE FUTURE

SIR,—As a university lecturer I resent Mr. S. G. Newstead's statement in your issue of February 14th that the university and teaching professions are concerned only with the acquirement of knowledge of the past. It is largely the research and discoveries made in the universities which have rendered modern engineering possible. To take only one instance—radio engineering. It is well known that the existence of this subject is almost entirely due to the work of university professors such as Clerk Maxwell, Hertz, Lee Forest, &c.

I am unable to speak for the other professions, so slightingly referred to in Mr. Newstead's letter. But the experience gained by school teachers leads to an understanding of human nature and an ability to help mould character which few engineers can possess to the same extent. School teachers, therefore, should be most useful in helping to plan a future leading to the progress and the happiness of the greatest number.

Mr. Newstead's thesis that engineers are peculiarly qualified to plan for the future cannot be maintained. This important task must be shared equally by all members of the community, and those who turn out to be unusually gifted for this purpose must be chosen to lead us, irrespective of their profession or occupation. C. FOX.

Surbiton, Surrey, February 20th.

PEACE AIMS

SIR,—The interesting letter by Sir Ernest Benn in THE ENGINEER dated February 21st relating to Peace Aims contained some highly important statements. "Our first duty is to strive to discover the causes of war," says Sir Ernest Benn. To my mind, this would not prove to be a very difficult problem. Europe to-day consists of nations possessing clever peoples, all having the common desire to expand, and to have the right of respect. The cause of war amounts to competition. The system of diplomatic and trade competition always leads to wars. Race hatred is fostered by the financial interests, helped by stunt newspapers and political movements. Peace in Europe will only be a possible thing by creating a United States of Europe. It is not an impossible ideal if the right men are chosen to bring it about. A system of "haves" and "have nots" is a worn-out method of managing the world. Unity of the world's peoples should be easier these days, as quicker travel, wireless, inventions, and the cinema have all helped towards better understanding. The common people in all lands hate wars, and it is up to them to elect peace-loving leaders. The world is blessed with food, materials, and beauty. It is madness to claim that it is "human nature" to bring about misery, slaughter, and poverty upon the masses in order to satisfy the cravings of a few. We must remember some of the reasons why the League of Nations failed in its object. In my opinion, too many of those who sat upon the League had self-interest, thus the fine ideals were lost. I have sufficient faith in humans to believe that they can be trusted to demand to live in peace in a United Europe. Churches, trade unions, and international friendship societies can make another war impossible if they put their backs into a real strong endeavour to make a world worth living in. Business men, too, can help in the great work, as in most instances they have all to lose when hostilities break out between nations.

LEONARD J. BARNES.

Croydon, February 21st.

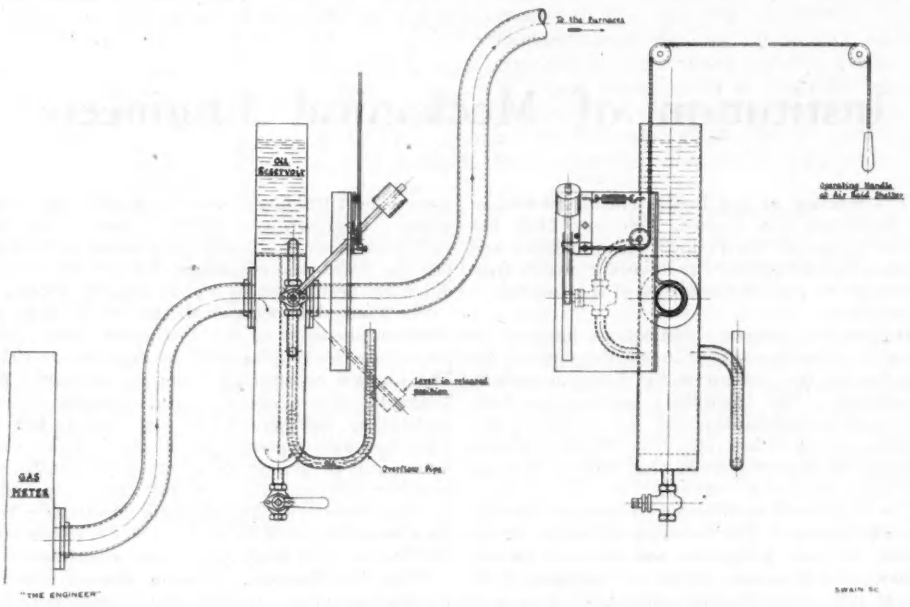
The Working of Gas Furnaces During an Alert

IN a factory where gas furnaces are used extensively the loss in production due to an "Air Raid Alarm" is probably greater than that from most of the other equipment in the factory, mainly because when the "Raiders Passed" is given the furnaces take some time to get up to the required temperature. At a factory in Derbyshire the spotters' system has been adopted and the practice in the past has been to close the main gas supply valves at the meters when the spotters' bell gives the alarm and open them again when the spotters' bell gives the "Danger Passed." As the meters are situated some 200ft. from the nearest shelter, a certain risk was involved in carrying out this work, particularly at night. At the same time, if these valves were left open and any bombs fall in the vicinity of the works it might take too long to get to them from the shelter, close them and return to the shelter.

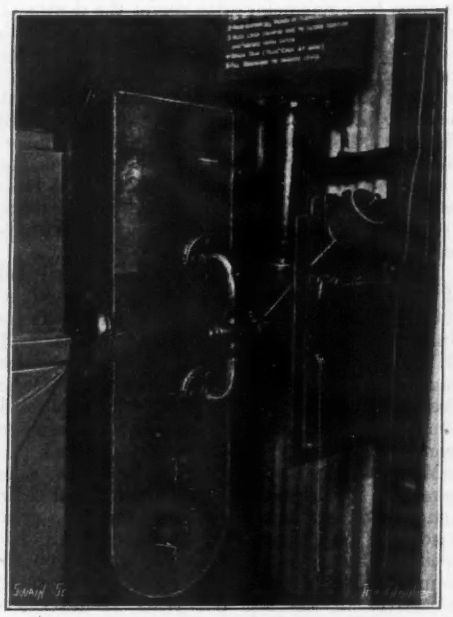
A good illustration of the difficulties involved occurred some months ago during a "nuisance" raid. The spotters called the men into the shelters four times during a three-hour alert. The gas was shut off on each occasion and turned on with "Danger Passed" signal. The result was that the furnaces no sooner were up to temperature when another spotters' warning was sounded and the temperature went down again. During this particular alert the rest of the plant lost very little output, but it was clear that something had to be done to overcome the waste of time and output from the furnaces.

The obvious course was to erect a shelter near enough to the meters to enable the men to shut the gas off with a reasonable amount of safety if any bombs were being dropped in the vicinity of the works. Unfortunately, this was not a practical proposition, partly on account of the position of the meter valves and their distances apart, and partly on account of the time taken to close the valves. It was therefore decided to introduce electrically operated valves with a switch for operating them in the shelter. Unfortunately, this idea had to be dropped on account of the time required by the makers to manufacture the valves. Motorised, and hydraulically and pneumatically operated valves were all considered and turned down because manufacture would take too long.

Finally it was decided by the firm to make its own valves in the form of a gas trap, as illustrated herewith. The trap consists of two chambers, the top one being a rectangular tank and the bottom one a rectangular chamber with a top plate and a division plate. This division plate stops short of the circular bottom plate so that the clear space between the two compartments of the chamber has a sectional area equal to that of the main gas pipe. These top and bottom chambers are connected by means of a pipe and plug valve. Gas passes from the meter through the trap and out to the furnaces, the top tank being filled with light oil in the winter and water in the summer. It is a simple matter to open the plug valve, allowing the liquid to flow into the bottom chamber and so stop the gas passing. The resetting of the trap is also very easy. The plug valve is closed and the liquid is drained from the base of the trap and returned into the top tank. The closing of all valves on the furnaces must, of course, take place before this resetting.



GAS TRAP VALVE



TRAP VALVE INSTALLATION

The company has three separate meters on the works, one passing 3000 cubic feet per hour and two passing 1000 cubic feet per hour each. During a rehearsal it was found that it takes fifteen to twenty seconds to stop the gas supply to the furnaces operating the three traps simultaneously from the shelter. Up to the present no occasion has arisen when it has been serious enough to necessitate the use of these traps, but it is certain that during recent weeks they have enabled the company to carry on production immediately after an alert. They are simple and cheap to construct and, providing the moving parts are kept free and well oiled, they will prove efficient. The furnace operators have instructions to run on half gas when the warning bell is given. The shelter warden is in charge of the remote controls, which incidentally are enclosed in a locked case and fastened to the wall inside the shelter. He opens this case during a spotters' warning and has instructions to pull the controls only if he is satisfied that bombs are being or are about to be dropped in the vicinity of the works.

MICA IN TANGANYIKA.—A report on the mica occurrences of Tanganyika has been issued by the Geological Division of the Department of Lands and Mines of the Territory. Up to the present, the greater part of the mica that has been exported from Tanganyika has been won from surface workings. In some of the better-known areas, however, opencasts have reached their economic limit in depth, and one company is now confining its attention to underground mining. In discussing the relative merits of the two methods, stress is laid on the possibility of further development of underground mining, because it is believed that the Uluguru Mountains, the main centre for mica in the Territory, present features peculiarly suitable for that form of work. The altitudes on these mountains range from 1000ft. to over 8000ft. above sea level, and the average gradient is of the order of 1 in 4, so that a considerable depth of backs is easily obtained from comparatively short adits, and shaft sinking and the expenses of shaft haulage and pumping are obviated.

The Mechanical Requirements of the Royal National Lifeboat Institution*

By Lieut.-Col. P. H. JOHNSON, C.B.E., D.S.O., M.I. Mech. E.†

Disposition of Lifeboats.—There are at the present time 170 lifeboats available for service at various points round the coast of these islands, and of these 143 are motor lifeboats. A total of 128 can be moored afloat in harbours or are housed in suitable buildings from which they can rapidly be launched down slipways direct into deep and protected water. There remain many hundreds of miles of coast line where such methods are not practicable. In these circumstances it becomes necessary for a proportion of the lifeboats—forty-two in all—to be launched from an open beach, the boat itself often being housed some distance away from where any launch can be made, especially at low tide.

Beach Conditions.—The beaches themselves vary from firm wet sand to deep layers of clean shingle composed of smooth and rounded pebbles with nothing to bind them together; the latter type forms one of the most difficult surfaces to deal with. Up to the point when the shingle approximates to coarse sand, the smaller the pebbles the more easily do they flow beneath the application of weight to the surface and thus the more difficult are the conditions for transport. Small wet and clean shingle approximates in behaviour to a fluid rather than to a solid. Sandy beaches may be complicated by dunes of dry wind-blown sand which also present considerable difficulty. Some beaches which may stretch for miles at low tide and are almost level abound in treacherous mud pockets which have their origin in adjacent river estuaries.

In the circumstances referred to, it will be appreciated that very special equipment is called for if a modern motor lifeboat which, complete with its carriage, weighs approximately 11 tons is to be hauled over the beach without difficulty. The first mechanical requirement therefore for beach launching of the lifeboat is that its weight shall be made movable without undue rolling resistance or sinkage over the surfaces described.

Width and Diameter of Smooth Steel-tyred Wheels in relation to Rolling Resistance.—Over a good hard road surface the rolling resistance of steel-tyred wheels can be as low as 30 lb. per ton weight of vehicle. Over a loose sandy beach this can rise to 200 lb. or 300 lb. per ton, and even more. In very soft patches, even with wheels of the largest practical diameter, sinking to a depth involving immobility—within practical limits of motive power—can readily be experienced.

While in certain cases a moderate increase in width can have beneficial results in minimising the liability to sinkage, yet increase in width alone is no answer to rolling resistance. If a steel-tyred wheel 4in. wide sinks into a soft surface to a depth of 2in., the cross-sectional area of the rut created will be 8 square inches. If by doubling the wheel width the sinkage is halved, then the cross-sectional area is not reduced, being still 8 square inches. As the cross-sectional area of the rut created is a reasonably accurate measure of the rolling resistance, little, if any, benefit has been obtained by doubling the width. Great advantage arises, however, from an increase in wheel diameter, as is indicated by Fig. 1. To illustrate the point, Fig. 1 *a* shows wheels 3ft., 6ft., and 12ft. diameter, respectively, so proportioned in width that they sink to an equal depth of 4in. in soft soil when equally weighted. It will be seen from the rut sections that the 3ft. wheel has to be rather more than double the width of the 12ft. wheel, and this is a fairly accurate measure of their respective rolling resistances. The same three wheels are shown in Fig. 1 *b*, but in this case they are all 6in. wide. With equal loading, the 3ft. wheel creates a rut more than three times the depth of that created by the 12ft. wheel.

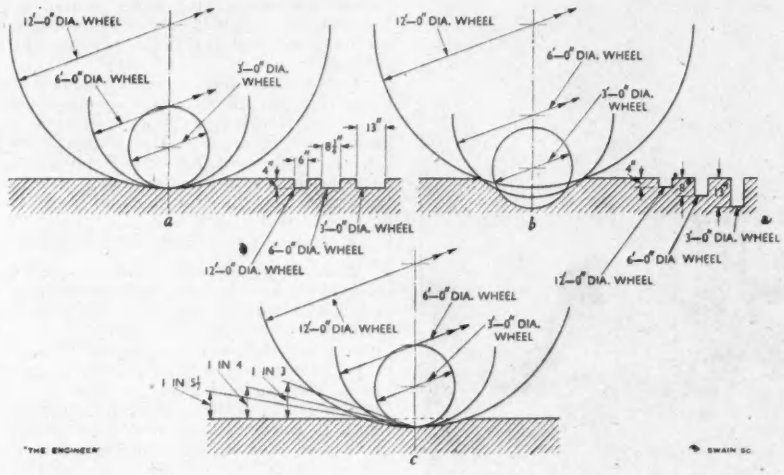


FIG. 1—*Effect of Width and Diameter of Smooth Steel Wheels on Rolling Resistance*

Actually, the figures given above are rather more favourable to the small diameter wheel than would be realised in practice. One factor which the figures do not reveal is the "angle of attack" illustrated by Fig. 1 *c*. This shows that, given equal depth of sinkage, the 12ft. wheel is, in effect, being called upon to climb a gradient of 1 in 5½, the 6ft. wheel a gradient of 1 in 4, and the 3ft. wheel a gradient of 1 in 3.

Evolution of the Girder Track Units.—After many years of design and experimental work, the type of track unit shown in Fig. 2 was evolved, and this, in its present form, enables the lifeboat to be carried without appreciable sinkage over surfaces where it is virtually impossible to walk. On a level beach with a reasonably firm surface the rolling resistance offered by the lifeboat and carriage mounted on these track units is of the order of 100–150 lb. per ton.‡ Under these conditions, therefore, a draw-bar pull of 1100–1650 lb. is all that is necessary to maintain movement.

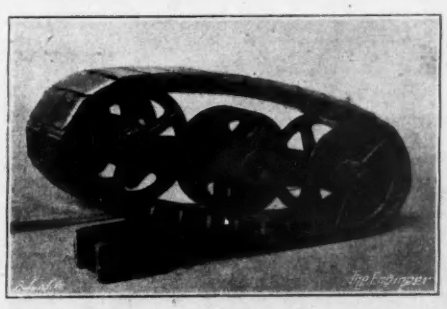


FIG. 2—*Rigid Girder Track*

FIG. 4—*Position of Lifeboat, Carriage, and Tractor when Carriage is Ready to be Pushed into Sea*

CONSTRUCTION OF LIFEBOAT CARRIAGE TRACK UNITS

The track employed for these units is commonly referred to as the rigid girder type, and in various forms has been well known for many years, though both the actual endless track and the complete units themselves as used for lifeboat work possess special features which are novel and not used elsewhere. In principle, the girder track itself is so constructed that it forms, in effect, the rim of a wheel of large diameter. The girder effect is obtained by interlocking the plates§ one with another, and a special feature of this particular design is that, as shown in Fig. 3, a double interlock is provided so that no stresses are thrown upon the hinge pin with the exception of such as are involved in preventing the elements of the track from falling apart when passing slackly round the ends of the complete track unit. Thus, these track pins are, for all practical purposes, immune from wear and tear. Pins which have been in employment for eight years and more show no reduction in diameter.

The curvature given to the track is essential from many points of view. It is true that if it were flat, in contact with the ground, better flotation without sinkage on very soft surfaces would be obtained, but rolling resistance and undue wear and tear would be set up by the necessity for the track plates to hinge into the locked position round the ends under load, whereas they now fall loosely into the locked position before the load is applied to them. Moreover, if the tracks were flat, steering of the vehicle would become difficult. The curvature given to the track is sufficiently slight, however, to ensure that when sinkage occurs in very soft ground the area of support rapidly increases.

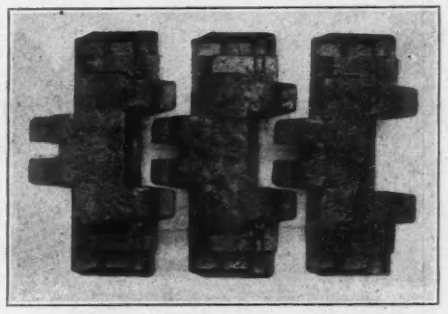


FIG. 3—*Double Interlock in Girder Track*

Another important feature of these track units is that the girder track, in combination with the pivoting of the unit about a central axis, provides for a rigid inclined plane up which the vehicle is borne when surmounting an obstacle (Fig. 2). Thus the draw-bar pull required when an obstacle is met is minimised. The track units shown in Fig. 2 are 22in. wide, though not more than about 20in. of this width is really effective for supporting purposes.

A novel feature of these girder track units not found in those built elsewhere is the centre wheel. Without this centre wheel the length of unsupported girder is doubled and the stresses imposed upon the girder quadrupled. If no centre wheel is fitted then the maximum stress in the girder is obtained when the unit passes over a rigid obstacle and this obstacle is immediately under the central axis. With the addition of the third or centre wheel the maximum stress in the girder occurs when the obstacle lies midway between one of the end wheels of the unit and the centre wheel; but in this position the load at the point in question imposed by the weight of the vehicle cannot exceed half the load imposed on the unit as a whole, owing to the fact that the unit is pivoting about a central axis. Hence the great advantage of the centre wheel.

It will be obvious that the three wheels which form the mechanism of the unit cannot perform their proper function unless the weight is at least approximately evenly distributed between them. Provision is made for this by means of a vertical adjustment to one of the end wheels by which means an alteration to the curvature of the girder occasioned by wear of the locking faces of the track plates can allowed for.

* Institution of Mechanical Engineers, February 21st. Abstract.
† Chairman and managing director, Roadless Traction, Ltd.

‡ Dynamometer readings taken since the paper was written show that the rolling resistance on concrete is 80 lb. per ton, on firm sand below high water 100 lb. per ton, and on soft sand above high water 120 lb. per ton maximum.

§ At the meeting the author said that fabricated links were now replacing castings. They weighed 45 lb. as compared with 62 lb. for castings and were rather stronger and more reliable.

Method of Launching the Lifeboat.—The tractor first hauls the lifeboat to that portion of the beach from which the launch is to be made, finally entering the sea to a depth of perhaps 2ft. or 3ft. Turning sharply then up the beach the boat is hauled in a shoreward direction until the bow of the boat, which is at the rear of the carriage, is facing the sea and at right angles to the breakers. The tractor is then uncoupled from the carriage and turned round; the front steering wheels of the carriage are locked and the tractor pushes the lifeboat seaward by means of the buffer provided for this purpose. Launching ropes which are fixed to the stern of the boat and pass round pulleys at the rear end of the carriage are brought back to the tractor and attached to eyebolts on the launching platform. When the tractor has pushed the lifeboat into the sea to a sufficient depth for launching, and the fastenings of the boat to the carriage have been released, the tractor is driven in reverse up the beach, when the pull on the launching ropes slides the boat into deep water off its carriage. The empty carriage is then hauled up the beach to await the return of the boat. Fig. 4 shows the position arrived at in preparation for a launch after the tractor has been reversed and placed ready to push the carriage into the sea.

In many circumstances the tractor has to be submerged to a depth of about 3ft., and holes are often found in the beach into which it may be submerged to a much greater depth. In stormy weather, which is naturally much more usual than otherwise, the breakers may pass completely over the tractor. Fig. 5 shows a launch on the coast of Holland. The conditions here emphasise the need for a submersible tractor.

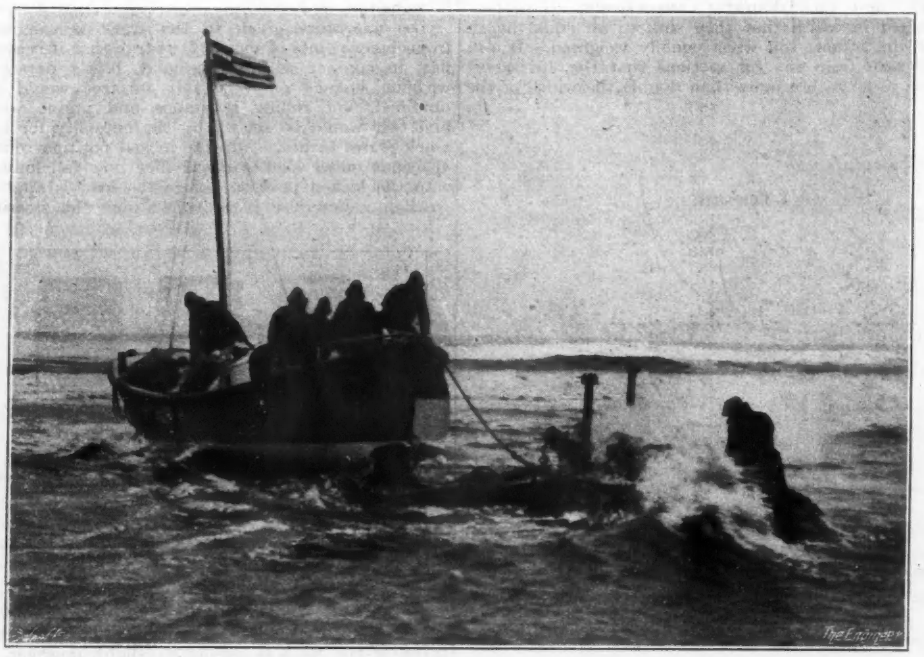


FIG. 5—*Launch on the Coast of Holland*

The Lifeboat Roadless Tractor

The most elaborate and thorough precautions are taken to prevent the possibility of mechanical failure or inadvertent stoppage. These may be summarised in the following nine paragraphs.

(1) Air for the engine enters through an intake at a height of 7ft. 6in. from ground level, the exhaust being carried to a similar height. The air vent for the fuel tank is also carried up to the same height as the air intake for the engine.

(2) A large casing of sea-water-resisting aluminium is provided on one side of the engine (see Figs. 6 and 7) for the housing of the sparking plugs and other electrical gear, which includes dual ignition, but does not include the starter motor or battery. Access to this chamber is provided by a series of water-tight, but easily removable, doors. The air intake for the engine is coupled to the forward end of this casing, thus ensuring that cool air passes over the electrical apparatus inside on its way to the engine.

(3) The driver's control board is enclosed by a casing in front of the operator, again of sea-water-resisting aluminium; movement to the outside of the casing for external operation is made through synthetic rubber diaphragms.

(4) It is impracticable to provide glands for waterproofing the governor gear, as this would interfere with its free working, so this part of the engine is completely encased in a separate housing.

(5) The box containing the batteries is placed to the rear of the fuel tank and engine, and in front of the driver's control box. Though this battery box is seldom fully submerged, it must yet be completely water-tight to be unaffected by spray and waves breaking over the tractor.

(6) In addition to the usual lighting equipment for travelling on the road at night, a powerful searchlight is mounted conveniently for the driver's control, and is an invaluable aid for launching on a dark night. All this equipment and the electrical leads associated with it are specially waterproofed.

(7) If under exceptional circumstances the tractor is unable to move the boat and carriage by direct haulage, then resort can be made to a bollard, provided at the rear end of the tractor, which is capable of giving a 10,000 lb. pull with the tractor stationary. Special gear is also provided for anchoring the tractor if necessary against the pull of the rope; but normally the resistance of the tractor to skid bodily, with the brakes fully applied, suffices.

(8) Other than those referred to, every possible inlet for water is "proofed" by some special form of sealing device or connected to the engine air intake. Such inlets include, of course, the crank case and gear-box "breathers." Many of these sealing devices would have presented far greater difficulties than were in fact experienced but for the comparatively recent introduction of synthetic rubber. Owing to the oil-resistant qualities of synthetic rubber (never attained to any appreciable degree by the natural product) it is remarkably efficient as a sealing medium. It is also used throughout the tractor for sealing such bearings as those of the weight-carrying rollers, bollard, steering shaft, &c. All sliding shafts are provided with glands and stuffing-boxes.

(9) A special ventilation valve, which is left open when the tractor is not in use, but is closed as soon as the engine is started, is provided to prevent accumulations of petrol gas which may lead to an explosion.

The endless tracks with which the tractor is equipped are of the rubber-jointed variety; the joints are thus immune from the action of sea water, sand, and corrosion. The tractor draw-bar is of the laterally swinging variety pivoted at a point sufficiently forward of the centre of ground contact to ensure that the draw-bar pull assists the steering.

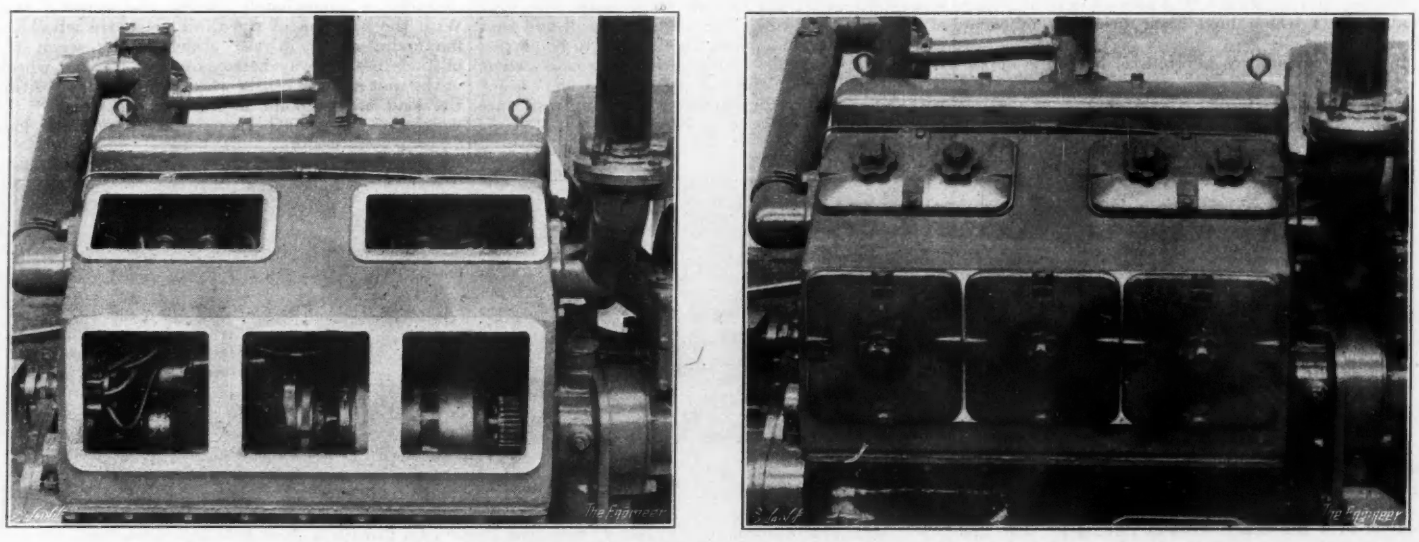
Tractor Tests when Submerged

When every possible precaution has been taken to ensure that the internal mechanism of a lifeboat roadless tractor is effectively water-tight, the most rigid tests are applied to ensure that nothing has been overlooked or is inadequate. The first of these tests consists in closing the exhaust and air intake pipes and subjecting the interior to air pressure. In this condition the tractor is submerged in water until it is completely covered, when the minutest leak of air is discernible. The first test of this nature is carried out before any oil is put in either the crank case or gear-box, as it has been found that oil tends to close a slight leak. After immersion for several hours under these conditions the internal pressure is released, oil is provided for the engine and gear-box, and the tractor is then run under water, being repeatedly stopped and started while submerged. In this way complete water-tightness in working conditions can be initially ensured.

Running and Performance Tests.—After concluding the submergence tests, each completed tractor is subjected to an eight-hour non-stop run at full engine speed before being dispatched to the coast for the final acceptance tests. The latter include a trial launch and the hauling of the carriage and boat over the most difficult portions of the beach ever likely to be used.

Internal Corrosion and Condensation.—Experience has shown that slight accumulations of water can be found in the enclosed parts of the tractor, which are not traceable to leakage. They are accounted for by condensation. It will be realised that after a launch when the engine is shut down, the interior is filled with moisture and salt-laden air, and that as the tractor cools and the heated oil drains from the metal surfaces, this moisture condenses on them and in a very few days can lead to serious corrosion.

To guard against trouble from this source, the standard procedure at all Royal National Lifeboat Institution stations where these tractors are in use is roughly as follows. Every time the tractor is used and before it is put away in the boat house, it is thoroughly hosed down with fresh water. The engine is run daily for a period of about fifteen



FIGS. 6 AND 7—*Housing for Ignition Equipment—Doors Removed and Doors Closed*

minutes, until thoroughly hot, the tractor at the same time being both moved and steered. Samples of crank case and gear-box oil are drawn off at frequent intervals from the lowest point to ensure that no leak has developed. Inspection of chambers not directly connected either to the sump or the gear-box is made at frequent intervals through the inspection covers provided.

Automatic Protection for Radiator Fan when Submerged.—While many unexpected difficulties were met with and overcome in the design and experimental stages of this tractor, there was one item from which trouble was expected and which in practice gave none. It was feared that when running into the water the radiator fan blades might easily be broken or distorted and that it would be necessary, though extremely difficult, to find means of enclosing the fan. In practice it was found that immediately on entering the water, before the fan blades actually came into contact with it, the water picked up by the fan belt acted as a lubricant and had the effect of stopping the fan from working as long as it remained under water. As the engine cannot overheat during this time and as the services of the fan are not required, no adverse results arise, and a few moments after emerging from the water the moisture drains away from the fan belt and the fan starts working again.

Works of Wild-Barfield Electric Furnaces, Ltd.

IN 1938, as a result of increasing evidence that the former works was inadequate to meet a growing demand for its products, the firm of Wild-Barfield Electric Furnaces, Ltd., took steps to prepare for the erection of larger works; and early in 1939 a site was chosen and purchased. In accompanying engravings we illustrate the works and laboratories.

The site chosen is readily accessible from London or the Midlands and North of England. The ground covers about 3 acres, with a good frontage on the main road. All plans for offices and works were prepared with future extensions in view. The works have been built mainly for the manufacture of relatively small furnaces, all the larger mechanically operated furnaces being designed and installed by the firm's associated company, G.W.B. Electric Furnaces, Ltd., for whom heating elements and other electrical details are manufactured.

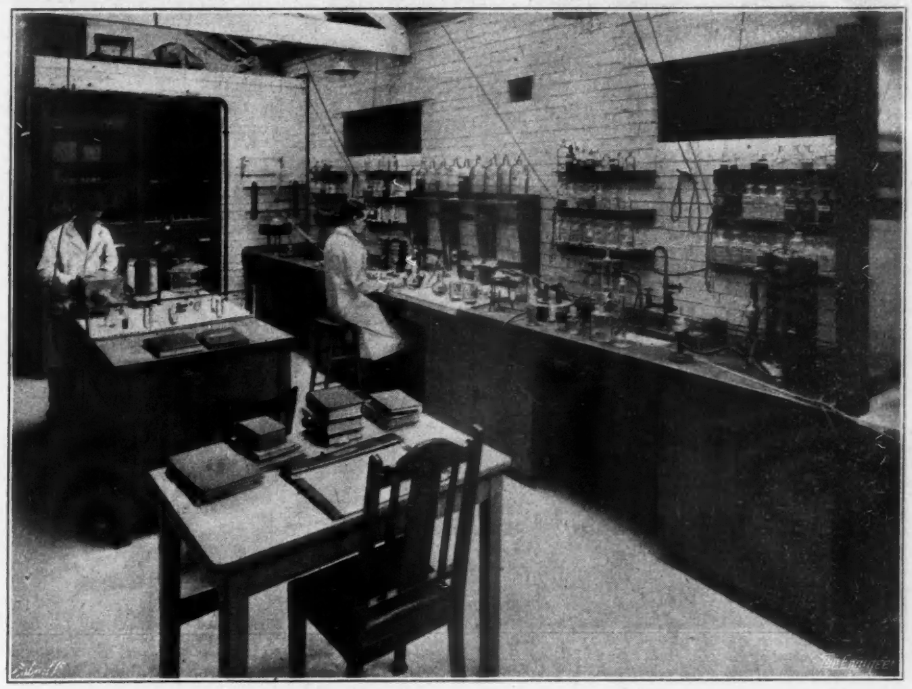
The main bays are each 40ft. in width, 27ft. high to the eaves, and designed to take 10-ton travelling cranes. The buildings are of the usual steel-frame construction adopted for such duty, with brick walls and special double asbestos sheeting on the roof. Provision is made for roof lights, but at the moment the frames are fitted with corrugated sheeting to avoid black-out difficulties and to minimise the damage from shrapnel and similar possible dangers. On return to normal times the roof lights will, of course, be fitted with a resultant improvement in general lighting. One of the bays stretches from the front of the office block towards the back of the site, with an 18ft. by 20ft. roller shutter door at the front and a slightly smaller door at the back. The front of this bay is the despatch department, and adequate lifting and handling facilities now provided will enable furnaces, which hitherto had to be erected wholly or in part on site at customers' works, to be erected and transported complete. Another bay is generally similar, extending to the same depth as the first bay, but adjoins the laboratory buildings behind the office block. A service road running the length of two buildings provides access to the far ends for delivery of raw materials. Daytime lighting is derived through windows in the side walls, extending to a height of 14ft. in some places and 20ft. in others. Artificial lighting is provided by electric discharge lamps, two rows being provided in each bay at a height of 26ft. and disposed to give a general illumination of 15–20 foot-candles. In addition, special lighting is provided in the machine shop and other departments, whilst plugs for hand lamps are fitted in pits where certain furnaces are assembled. Heating is carried out by hot water, with motor-driven fan radiators mounted about 12ft. above floor level. The boiler-house, with solid fuel boiler, serves not only the works, but all other buildings, including offices, laboratory and canteen.

Machine tools do not figure very prominently in electric furnace manufacture, but the majority of those installed have individual drive by Brook motors. All the new machines are so arranged and include lathes, drills, shapers, grinders, &c. Rolls for plate and angles, shearing and guillotine machines, both motorised and hand operated, are amongst other plant installed. Welding equipment is used extensively, both oxygen-acetylene and electric welding being employed. The latter includes spot welding and arc welding, several machines being in fairly constant use. Other items of equipment include paint spraying, which is carried out in an enclosed compartment, and the usual bench and portable drills, grinding wheels, and so on, for which low-voltage plug points are provided throughout the shops.

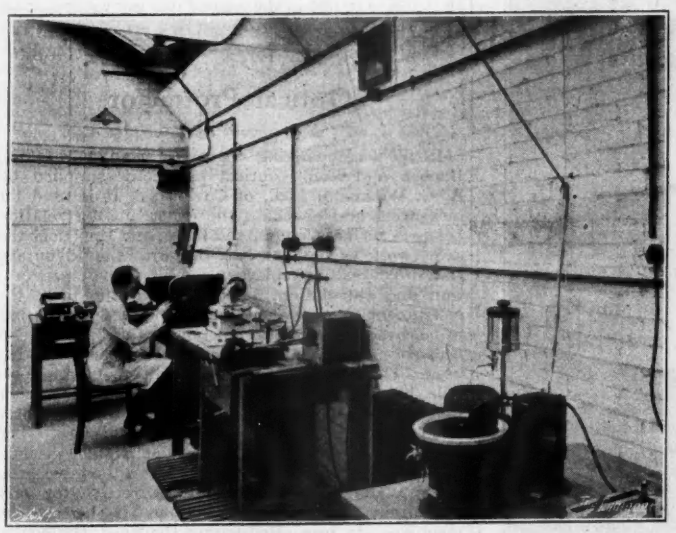
A test department is well equipped, and is grouped with the main distribution panels. The electric supply is taken from the Corporation mains at 415 volts, three-phase, 50 cycles, this supply feeding all the main plant. The test bay has a three-phase transformer, 150 kVA capacity, to give voltages from 20 to 600, a Scott-connected group to give a two-phase output, at a variety of voltages, and a 50-kVA single-phase transformer. These various transformers have the tappings brought to terminals on test panels, with ammeters and voltmeters of various ranges. The 110-volt tapping on the three-phase transformer is also used to supply the portable drills, &c., which, although single-phase, are balanced as much as possible on the three-phase mains.

A single-storey laboratory building is divided into chemical and physical sections. The chemical department accommodates a brick-built storeroom and has titration benches arranged along one side and furnace bench along the other side. The physical department accommodates the testing equipment for tensile, impact, hardness testing, &c., and also houses the dark room for photomicrography and spectroscopic analysis. The balance room is also situated in this section. Near the laboratory is the heat-treatment shop. Many of the furnaces have been removed to fulfil the urgent demand for plant, but those remaining are sufficient for small-scale experimental work and additions are being made as circumstances permit. Adequate lifting and quenching facilities are available, together with equipment for the production of protective atmospheres. High and low-pressure air lines are fitted here and in the laboratory building, and the electric supply is arranged to provide means for the fluctuating demands likely to be met.

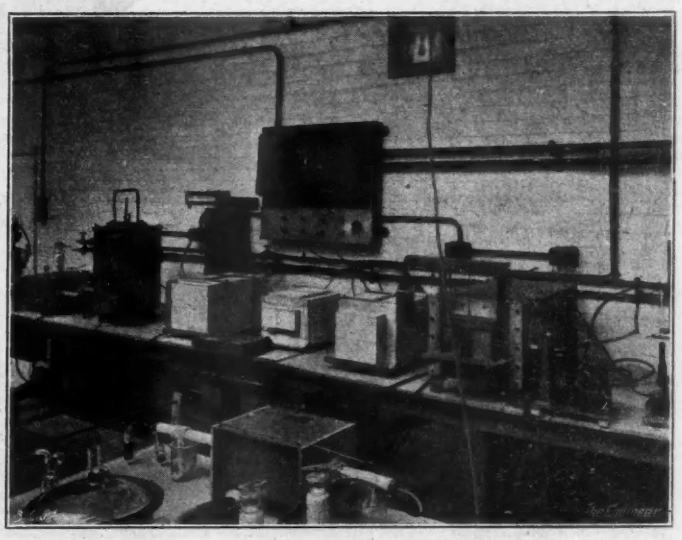
The office block is a two-storey brick and reinforced concrete building with direct access to the works. The main entrance is at one end of the block and arranged so that after final extension to the offices it will be centrally situated. Each floor has a central corridor with the individual offices opening on to it. The ground floor comprises drawing-office, general office and staffs connected directly with the



CHEMICAL LABORATORY



PHYSICAL LABORATORY



FURNACE BENCH IN CHEMICAL LABORATORY

works and production. In addition, the A.R.P. control room and telephone switchboard are combined in a brick and reinforced concrete room near the entrance hall, a heavy steel plate door providing adequate protection inside the building. The second floor accommodates sales, accounts and executive offices.

A canteen has been built near the works and offices. The usual fire fighting, first aid and A.R.P. services are adequately catered for, and underground reinforced concrete shelters are provided. In addition to post office phones throughout the offices and works, automatic internal telephones have been installed throughout, whilst a staff locator system is provided to minimise the delay in finding any individual who may be wanted on the telephone or otherwise. The whole of the work has been carried out under the supervision of Mr. J. P. Coleman, the works director, the main contractors for the works buildings being Gibbons Bros., Ltd., of Dudley, and for the offices R. C. Campbell.

ERECTION SHOP

Extensions at Detroit Edison Company's Delray Power Station

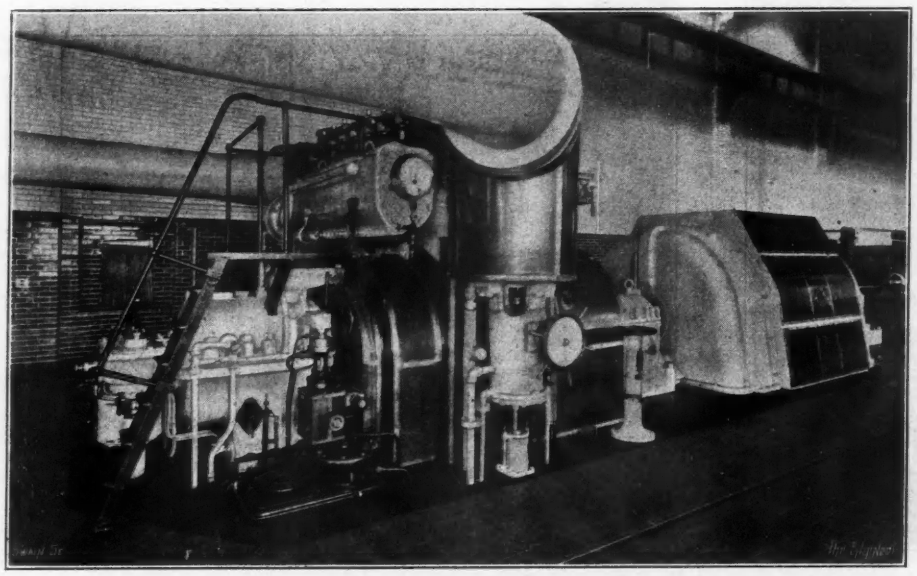
ONE of the methods of improving the efficiency of the steam turbine which has been investigated during recent years is the operation of the turbine with extra high-temperature steam. As a result of investigation carried out in the B.T.H. turbine department, an order was placed in 1928 by the Detroit Edison Company, United States of America, for an experimental B.T.H. turbo-alternator to be built for a rating of 10,000 kW, 3600 r.p.m., and to work with steam at 365/400 lb. per square inch gauge pressure and a total temperature of 1000 deg. Fah., this temperature being higher than anything that had been attempted up to that time. The set was installed in 1930 in the Delray No. 3 power station, which had just been built to house three 50,000-kW turbo-alternators working with steam at 375 lb. per square inch gauge pressure, and 700 deg. Fah. total temperature, and the operation of the experimental set proved very satisfactory.

When the Detroit Edison Company decided, at the end of 1937, to extend the Delray No. 3 power-house to accommodate three additional 75,000-kW sets operating on steam at 815 lb. per square inch gauge pressure, 900 deg. Fah. total temperature, it also decided to have the 10,000-kW high-temperature set rebuilt for topping service as a link between the old and new sections of the plant. The order for this work was placed with the B.T.H. Company, and the new 10,000-kW set—shown in the accompanying illustration—was installed in the autumn of 1939. The turbine operates on the same steam conditions as the new 75,000-kW sets, and exhausts at 410 lb. per square inch gauge pressure into the main steam header of the low-pressure section, the temperature of the exhaust varying from 740 deg. Fah. at full load to 780 deg. Fah. at 2000 kW. The advantages of this arrangement are that a considerable amount of power is generated at low heat rate, and something like 500,000 lb. of steam per hour are transferred from the high-pressure section to the low-pressure section which needs it on heavy loads.

In its reconstructed form, the 10,000-kW turbine is a single-casing, 3600 r.p.m., eight-valve, nine-pressure stage unit built around the shaft and integrally forged wheels of the high-pressure rotor of the original machine. In addition to the shafts and wheels, the following parts of the original unit have been used — Stop valve (in parallel with a new stop valve) governor, main and auxiliary oil pumps, cam gear, oil tank base under governor-end pedestal, centre pedestal and pedestal support between the original H.P. and L.P. cylinders, and coupling between alternator and original L.P. shaft. The turbine casing, diaphragms, wheel buckets, steam chest, control valves, and other parts not already mentioned are new.

The governing arrangement is, perhaps, the most interesting feature of the superimposed turbine. Hydraulically operated devices are installed to perform under the following conditions :—(1) Primarily a centrifugal speed governor and relay regulate the steam flow. (2) With abnormally high back pressure, an overpressure regulator readjusts admission valve openings to reduce the steam flow as necessary to an adjustable predetermined limit. (3) If the back pressure reaches a preset high limit irrespective of the operation of the overpressure regulator, safety valves relieving to atmosphere will open to protect the turbine and piping from damage due to excessive back pressure. (4) With abnormally low back pressure, an underpressure regulator readjusts the admission valves to increase the steam flow ; the underpressure regulator is adjustable to maintain any desired value of subnormal back pressure. If, in spite of this readjustment, the back pressure continues to fall, a differential-pressure control overrides the underpressure regulator to restrict the steam flow to a value which will avoid too great a pressure differential across certain lower-stage diaphragms ; this will also act to prevent excessive generator loading. (5) Should the machine lose its load when the underpressure regulator is functioning, the speed governor will normally take over control as soon as the speed commences to rise, thus preventing overspeed. None of the back pressure-actuated devices actually supersedes the speed governor should the generator become separated from the system or in any other way drop its load. (6) Failure of oil pressure causes the main stop valves to close. (7) In the event of overspeed, an emergency speed governor of conventional type operates to close simultaneously both stop valves and all eight control valves. This governor may also be operated by a manual trip.

Besides the various governing devices installed on the superimposed unit, it is essential to provide some additional protective apparatus to safeguard its operation and that of the low-pressure section of the plant to which it exhausts. The first of these extra safety devices is a reverse-current relay which will operate the machine breakers to disconnect the generator from the bus-bar in order to prevent "motoring" the generator in case the turbine trips out for any reason, such as overspeed or failure of oil pressure. The necessity for this reverse-current protection arises from the fact that the windage loss of the turbine running at full speed in a steam atmosphere at 400 lb. per square inch gauge pressure will amount to an estimated 1170 kW. It should be understood that the windage loss is nowhere near this figure when the machine is carrying load, but if its steam supply were cut off and the turbine were driven at full speed by the generator acting as a motor, this estimated loss would occur. Considering only the amount of steam contained within the clearance spaces of the turbine, the 1170-kW windage loss would cause a rise of temperature at the rate of from 100 deg. to 200 deg. Fah. per second. In addition to the steam contained within the turbine, however, there is a large mass of metal which will be heated due to windage, and this has the very beneficial effect of reducing the rate of temperature increase to about 65 deg. Fah. per minute. It is obvious, however, that the unit must not be allowed to "motor" very long. The reverse-current relay will operate on a time delay of sixty seconds, and it is believed that no ill-effects will result from a turbine trip-out with this relay operating. Neither is any dangerous temperature to be expected in bringing the turbine to rest in the normal manner without load.

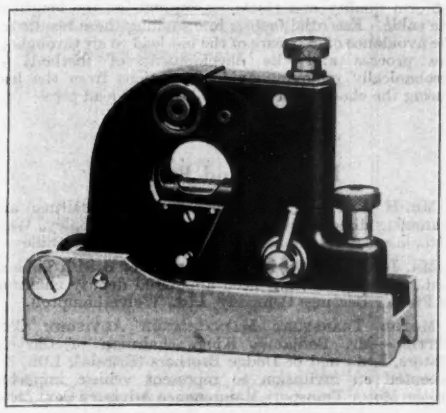


10,000-KW TURBO-ALTERNATOR AT DELRAY POWER STATION

Optical Protractor

IN an accompanying engraving we illustrate the Bausch and Lomb optical protractor supplied by A. C. Wickman, Ltd., of Coventry. It is used for measuring and checking the exact angular relation between surfaces, edges, and holes, and thus does the same work as the sine bar, but with the advantage that direct reading replaces a combination of mensuration and calculation. According to the firm, the instrument is equivalent in use to the 5in. sine bar in accuracy, but does not necessitate the use of accessory equipment as when the sine bar method is used. The optical protractor is built upon an adjustable base and the ring centre of the instrument revolves, carrying with it a spirit level and protractor scale which are viewed through an eyepiece. The scale is equipped with a vernier which permits direct reading to 1 min. of arc. The adjustable base enables the protractor to be corrected for any inaccuracy from the true level in the bed of the machine. In use, after truing the base, the centre ring is merely revolved by hand or by the micrometer screw which acts as a fine adjustment until the

required angle appears on the scale. The protractor is then placed upon the work, which is then turned until the level bubble becomes central, a quick, simple, and accurate method. The specially designed base has provision made for using the instrument upon round stock. For this purpose the slotted V base with a secondary level is provided, permitting quick and accurate measurements of round as well as flat surfaces. The scale and vernier are completely

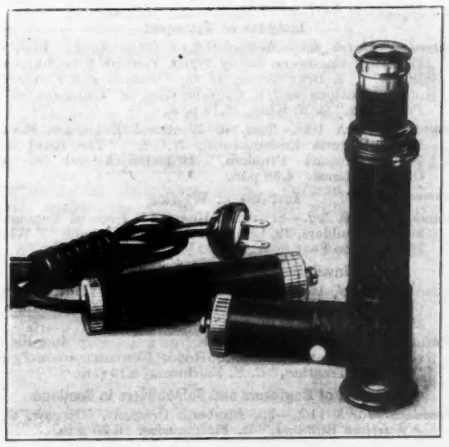


OPTICAL PROTRACTOR

housed in a strong metal casing into which is also mounted the spirit level. The specially slotted V base is of hardened and ground steel.

Brinell Microscope

THE improved Bausch and Lomb Brinell microscope illustrated, which is supplied by A. C. Wickman, Ltd., of Coventry, has a magnification of 20×, as compared with 12·7× magnification obtainable with the previous model. It covers a field of approximately 8·2 mm., and employs the new cone type eyepiece which gives an effectively longer eye distance than the flat-top type. The eyepiece scale is calibrated to read, in tenths of millimetres, the actual size of the Brinell impression. The adjustment of this eyepiece scale is made at the factory, the draw tube being held in position by a clamping



MICROSCOPE WITH DRY BATTERY AND TRANSFORMER ATTACHMENTS

ring, and the collective lens mount being held by a spacer ring and a setscrew in the draw tube. The eye lens, which can be focused, enables a sharp image of the scale to be obtained. The bottom of the base of the microscope lies in the object plane, and when the microscope is set on a flat surface, that surface appears in focus. For use with an external source of light, the base has an opening in the side to admit light, and a flat annular mirror to reflect this light down on to the specimen. Two other bases are obtainable. One contains a small flashlight bulb and battery, and the other a bulb and transformer for use with 220 volts A.C. Each of these two bases employs the flat annular reflector. The bottoms of all three bases are made of cold rolled steel to withstand the hard usage to which these microscopes are sometimes subjected.

INDIAN INDUSTRIAL RESEARCH.—A sum of Rs. 200,000 has been granted by the Government of India towards the expenses of a further number of immediately important industrial research schemes. Of the sum mentioned, a grant of Rs. 50,000 will go to establish a pilot rayon plant at Bombay; Rs. 10,000 is to finance sulphur borings to be carried out by the Geological Survey, and a further Rs. 10,000 will assist an investigation of vacuum and compressor pumps.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer

Business Conditions in Canada

A report issued by the Royal Bank of Canada shows that business conditions in the Dominion during 1940 were profoundly influenced by the war. The transformation to war economy was affected without undue dislocation, and barometers of business activity practically all record an expansion during the year. The intensive mechanisation of modern warfare led to an insistent demand for new types of weapons and equipment, and supplies of all kinds were required for the maintenance of the Fighting Forces and their transport. Canadian industry was quickly adapted to meet new requirements imposed upon it, and as orders were issued operations speedily got under way. War orders necessarily had a vast influence on the tempo of Canadian manufacturing operations which have averaged nearly 25 per cent. above the level prevailing in 1939. This was particularly noticeable in the heavy industries. The Canadian iron and steel industry is operating at the highest rate in its history with a back log of orders sufficient to ensure the maintenance of capacity operations for many months. The production of pig iron in Canada was 61 per cent. greater than in the previous year, and the output of steel ingots increased 48 per cent. Automobile plants have been active with over 75 per cent. of their output comprising military vehicles, many types of which are now being produced in Canada. New plants for the manufacture of aircraft are coming into production, whilst the older and larger companies are steadily increasing their operations. Shipbuilding is more active than for many years. The chemical industry has greatly increased its facilities and is producing or will produce all the chemicals used in the manufacture of explosives, including some which have hitherto not been produced in the British Empire. Preliminary estimates for the mining output places it for 1940 at the highest in Canadian history. Building construction last year in Canada rose by 90 per cent.

The Pig Iron Market

The position as regards supplies of pig iron in Great Britain is regarded with some degree of satisfaction. It is true there is some stringency in the hematite market and low-phosphoric pig iron is not in such plentiful supply as might be wished; but imports of both these descriptions have enabled deliveries to be maintained at a rate which has prevented any serious inconvenience to consumers. The Control carefully supervises distribution, and by checking the use of hematite in cases where other sorts may be utilised has conserved supplies. The British production of hematite has been pressed to the utmost extent and the output in this department appears to be steadily improving. The demand for foundry pig iron has increased during the last few weeks and is still slowly expanding. This is probably because of improved conditions in the light castings industry, which, in the latter part of last year, was working at below capacity. Government work has been given out to this industry, however, and although the foundries are still not fully employed, they are much better off for orders. The machine tool and heavy engineering foundries are extremely busy and practically the whole production goes to fill Government requirements. These industries largely require low-phosphoric and hematite iron, and lately larger quantities of refined pig iron have been used. The raw materials position in the pig iron industry is sound, and lately there have been greater quantities of cast iron scrap available. There is some speculation also in the trade as to whether freer supplies of ore will result shortly from our victories in North Africa. The position in the basic iron section of the market does not cause anxiety as the home production is at a high level and considerable imports are arriving.

The Midlands and South Wales

All the Midland steel works are fully occupied and have enough work in hand to keep them busy for several months. Great efforts are being made to increase outputs, with the result that a high level of production has been maintained, and most of the works are operating at capacity. The war demand continues to absorb by far the greater proportion of the finished steel output and all departments are operating under great pressure. The great activity proceeding at the shipyards is reflected in the heavy demand for plates and certain sizes of sections which has created somewhat tight conditions. Not only have the plate works to meet the requirements of the shipbuilders, but there is an insistent call from the tank and boilermakers. The engineering concerns, which are practically all employed upon war work, are big consumers of steel bars, large and small, and recently the call for these products has been keen. Small bars are taken up in considerable quantities and the re-rolling works are producing at a high rate, but even so can scarcely keep abreast of the needs of the consuming industries. An important business has been passing lately in bright drawn steel and cold rolled strip, which are required in large quantities by the aircraft and armament industries. Whilst supplies of these materials are not tight, they are only readily obtainable for work coming within the high priority category. The needs of the collieries have to be met and large tonnages of colliery steel, including arches and roofing bars, are being taken up. All the sheet works in the Midlands are producing at as near to capacity as is possible, and their output goes principally into war work. In South Wales the production of iron and steel is maintained at a high rate. The tin-plate market has become somewhat quieter as a result of the restriction on export sales, but there is an insistent demand for sheets which are being produced in large tonnages for war purposes. The demand for the heavy categories of finished steel has, if anything, increased, and all the producing works are operating at capacity.

The North-East Coast and Yorkshire

Although the demand for iron and steel for the war industries has considerably increased, the great efforts which have been made to press production to the utmost have enabled the industry to meet the needs of consumers. There has been some change over of production at the various works in order that the output of the descriptions of steel chiefly in demand should be adequate. The insistent request for semi-finished steel is taxing the resources of the British works, but is supplemented by imports from the United States. In some cases works normally producing rails are now devoting their attention to the manufacture of billets. The situation so far as billets are concerned, however, is now fairly satisfactory, and most of the consuming works have fair stocks. The re-rollers are thus able to press their output to the limit and large tonnages of small bars, sections, and strip are being turned out. There is an increased demand for the products of the re-rollers which are being used in the manufacture of the new indoor air raid shelters. All the finishing departments of the steel works are extremely busy, and there is not likely to be any relaxation in the pressure whilst the war lasts. Plates are in urgent demand, but it would appear that there is a slight easing in the stringency which was noticeable a few weeks ago. The Yorkshire steel industry is working under great pressure, and efforts are continually being made to increase production. The demand is principally for basic steel, and the plants are running at capacity; but there is an increasing call for acid carbon steel and alloys and special steels.

Copper and Tin

The British copper situation continues satisfactory in as much as the war industries are obtaining all their essential supplies, and whilst distribution is carefully supervised by the Control there are no complaints of works being inconvenienced by delayed deliveries. Supplies appear to be reaching this country with regularity and in sufficient volume to meet wartime requirements. In the United States the situation has not apparently altered. The tightness in the market does not seem to be so severe as some reports would indicate, and there seems little ground for the suggestion which has been put forward in some quarters in that country that there is likely to be a shortage during this year. When it is remembered that supplies of copper to the countries overrun by Germany have been cut off by the blockade and that the production on the American continent is expanding, it seems reasonable to anticipate that even should the British and United States requirements for war and rearmament purposes increase considerably there should be sufficient copper to meet the situation. It has been suggested that even with the purchases of 200,000 tons of Chilean copper made by the American authorities the position could continue tight. This would appear to have little basis in fact, particularly when the large quantities of copper scrap which will arise are taken into account. In pre war days Germany took important tonnages of copper scrap from the United States, and these supplies are, of course, now available for use elsewhere. Prices in America are unchanged at 12.50c. d/d and 10.50c. f.a.s. for export. The licensing system appears to be working smoothly and export permits are available for Great Britain and Empire countries. . . . The tin market has experienced a sharp advance in prices during last week and the beginning of this week. This was due principally to rather panicky buying on the part of consumers in the United States resulting from the Far Eastern crisis, and a certain amount of speculation on the London market. It is possible that the advance was not altogether justified by the actual position, but the United States buys considerable quantities of tin in the Far East, and as these purchases have to be shipped across the Pacific it is possible that in an emergency they might have been interrupted. It is suggested that the American authorities intimated that if the market situation got out of hand they might have to step in and regulate it, and this had a calming effect upon the market. The backwardation has sharply increased, but the reason for this is regarded as something of a mystery as it is not known what interests are responsible for the purchases of cash tin which have caused the movement.

Lead and Spelter

The lead position in Great Britain continues satisfactory, but there have been some reports lately that it may deteriorate in the future. These apparently are the outcome of the situation which has developed in the Far East, since a good proportion of British supplies comes from Australia. It is probable, however, that stocks exist in Great Britain since the position of lead has been easy, all things considered, ever since the outbreak of war. In the United States the position does not appear to have changed, and whilst prices remain firm supplies do not appear to be tight. The price is unaltered at 5.65c. New York. The producers in the United States have well-filled order books and are not pressing sales to consumers who are getting all the metal they want, although, naturally, the demand has increased as a result of the United States rearmament programme. . . . Notwithstanding the heavy and increasing demand for spelter British consumers are getting their full requirements; but, at the same time, there does not appear to be any surplus for industries which are not regarded as essential to the national effort. The recent tightness in the American position is still in evidence, but the quotation is retained at 7.25c. East St. Louis. There is practically no spelter for export to the United States, and some consumers are finding it difficult to obtain all the metal they require. The efforts which have been made to increase the smelting capacity there are being speeded up, and it is expected that a part will come into operation this year.

Notes and Memoranda

Rail and Road

FEWER NEW LORRIES.—According to official figures, only 2293 motor vehicles (including 176 cars, 465 cycles, and 834 agricultural engines) were registered as new in December compared with a total of 37,181 in the corresponding month of the last pre war year.

L.M.S. SALVAGE RECORD.—During 1940 employees of the L.M.S. Railway salvaged 9940 tons of waste material. Included in this total was scrap metal, 4831 tons; paper, 3129 tons; timber, 1135 tons; and rope, 534 tons. All this material has been collected at stations, carriage sheds, engine depôts, refreshment rooms, and other similar places, and is in addition to scrap recovered from company's workshops.

SNOW AS A PROBLEM.—Heavy falls of snow in early December were unprecedented in Ontario, Quebec and the Maritimes, and have served to emphasise the importance of preparedness in municipal quarters. From Canadian and American journals to hand recently it is evident that the snow problem has led to the development of a specialised branch of engineering to meet the need for prompt action on the roads.

SCRAPPING A RAILWAY.—The demolition of a section of 11 miles of New York's Ninth Avenue elevated railway is proceeding rapidly. The work was begun in October and already the removal of the heavy steel is two-thirds complete. A total of 7000 tons of rails and 55,000 tons of structural steel will be removed, and as none of the steel is to go out of the country it is loaded on barges for shipment to New Jersey, whence it is transported by rail to Pennsylvania steel mills.

SHIPPING LOCOMOTIVES TO INDIA.—Railway engines for India have recently been transported in specially designed ships owned by a Norwegian company. The war along the western seaboard of Europe has necessarily prevented their use for this purpose, and five engines were carried to India last year in five separate British merchant ships, all of which left Great Britain on different dates. The locomotives were dismantled and all the more valuable fittings packed in wooden crates.

UNDERGROUND IN NEW YORK.—An addition to the transit facilities of Manhattan Island was made when the Sixth Avenue underground railway was opened recently for public traffic. This line, which is stated to have cost £15 million to build, has been under construction for four years. It extends some 2¼ miles from the Washington Square station of the former "Independent" subway system. This route was formerly served by the Sixth Avenue elevated railway, which was dismantled in 1939.

A CENTENARY.—The Stockton and Hartlepool Railway was opened for all traffic on February 9th, 1841, but some mineral trains had been running since November 12th, 1840. The Stockton and Hartlepool Railway, which was begun in May, 1839, without the authority of an Act of Parliament, was really an extension of the Clarence Railway, connecting Billingham with Hartlepool. The resident engineer was Mr. (afterwards Sir) John Fowler, of Forth Bridge fame. The Stockton and Hartlepool Railway was 8 miles in length.

Air and Water

NAUTICAL TABLES WANTED.—Volumes of nautical tables are required for navigational purposes in H.M. ships, and in view of the shortage of paper it is suggested that unwanted copies of Inman's, Burton's, and Norris's Nautical Tables might be sent to the Hydrographer, Admiralty, London, by whom they will be distributed to ships requiring them.

THE "ORANJE."—The "Oranje," of 19,850 gross tons, built at Amsterdam in 1939, is to be converted into a hospital ship, and then be presented to the British Government for the evacuation of British casualties in the Near East. The Dutch East Indies Government will bear the cost of fitting out and will supply the medical staff. The "Oranje," built for service to the Dutch East Indies *viâ* Genoa, logged 26·3 knots on trials, making her the fastest motorship in the world.

DIVIDING A CONTRACT.—The recently placed contract for the construction of sixty 10,000-ton deadweight cargo vessels for Great Britain in America has been divided between two affiliates of the Todd Shipyards Corporation. Thirty of the vessels will be built by the Todd California Shipbuilding Corporation, at a yard to be constructed at Richmond, Cal., and the remaining thirty will be built by the Todd-Bath Iron Works Shipbuilding Corporation at Portland, Me., which also will build new ways.

CANADIAN SHIPBUILDING.—Orders for merchant ships continue to be placed in Canada by the British Government. It is reported that the Burrard Dry Dock Company, Ltd., Vancouver, and the Davie Shipbuilding and Repairing Company, Ltd., Quebec, have each received a contract for six cargo steamers of 9300–9500 tons deadweight. The designed speed of the vessels is said to be in excess of 10 knots. The first launch at Vancouver is expected to take place in a year's time, and the six ships to be completed in two years.

A STOCKHOLM SHIPYARD.—The Finnboda Shipyard, which passed to Svea shipbuilding interests a year or two ago, has been, and is being, extended by the new owners. The extensions already carried out have entailed an expenditure of about one million Swedish kronen. Further extensions have been decided upon recently, which will involve an expenditure of a further million kronen, and will be completed within the years 1941–43. The present fitting-out quay will be replaced by one of steel and concrete, on which a 5-ton travelling crane will be provided so as to serve two vessels lying alongside each other. The old battleship slipway is to be lengthened to provide for building vessels up to 400ft. long. The provision of a big floating dock has been decided upon in co-operation with Stockholm municipality with a capacity enabling it to lift ships of 14–15,000 tons deadweight. It will be the only one of this size and capacity on the Swedish east coast.

THE BOX BUTTE DAM.—Construction work was recently begun on the Box Butte irrigation dam, 7 miles north of Hemingford, Nebraska. This project, which is being carried out for the United States Bureau of Reclamation, will be a rock-faced earth dam, approximately 4200ft. long and 64ft. high. It will impound Niobrara River flood rivers to irrigate 12,000 acres in the Mirage Flats region in Central Sheridan County.

A LAMINATED BRIDGE ARCH.—A small bridge recently erected at Madison, Wis., U.S.A., embodies an unusual constructional feature. It has two 73ft. arches made from 1in. by 8in. pine boards surfaced on both sides, bent to the required curvature, and bonded together with casein glue. The arches are spaced at 6ft. centres with metal cross bracing to guard against sway. The floor is 3in. by 8in. redwood plank laid with ¼in. spaces and attached to the arches with wood screws.

Miscellanea

CANADIAN TUNGSTEN.—The Dominion Government is investigating the extent of the tungsten ore deposits recently discovered at Gilmore Lake, which have assayed 57·61 per cent. The ore is already being developed in another deposit, which has approximately 0·88 oz. per ton of gold, and a balance of tungsten and copper.

RESEARCH IN BRAZIL.—The President of Brazil, by decree, has established a National Mining and Metallurgical Council to be composed of native Brazilians who are specialists in mining and metallurgy. The Council is composed of seven members and has offices in Rio de Janeiro. The functions of the Council are to study the problems of the mining and metallurgical industry.

EXPORT GROUP FOR HEATING APPLIANCES AND ACCESSORIES.—This has been recently formed and duly recognised by the Board of Trade Export Council. Manufacturers included in this group are covered by the general classification of "All plant in connection with heating." The Chairman and Secretary is Mr. Arthur G. Marshall, and several well-known concerns are represented on the Executive.

MORE WHALE OIL.—A whaling fleet of three factory ships and twenty-one killers will sail from Halifax, Nova Scotia, next autumn for the Antarctic. Between 1000 and 1500 men will sail with the expedition, which is being made under the joint supervision of the British Government and the Norwegian Government now in London. Each factory ship is capable of holding between 10,000 and 15,000 tons of whale oil.

A BIRMINGHAM FELLOWSHIP.—The Council of the University of Birmingham announces that an anonymous donor is to provide for a period of seven years a valuable Fellowship in Chemistry, to be known as the Chamberlain Research Fellowship. Mr. Charles Brotherton has made available, from the Brotherton Trust, two post-graduate scholarships, each of the value of £150 per annum, for students in the Department of Chemistry at Birmingham University.

A USE FOR NATURAL GAS.—An ammonium nitrate plant is to be constructed at a cost of eight million dollars in the Turner Valley, south of Calgary, in Alberta, and operated by the Alberta Nitrogen Company, a subsidiary of the Consolidated Mining and Smelting Company of Canada. The Dominion Government is to retain ownership of the plant. The company will utilise between 10 and 12 million cubic feet of natural gas daily as a source of hydrogen for ammonia synthesis.

MOSCOW SOVIET PALACE.—The engineers of the U.S.S.R. have completed the foundations, begun in 1935, of the Palace of Soviets at Moscow, designed to be more than 1300ft. high. It will surpass in height New York's 1248ft. Empire State Building, now the tallest man-made structure. A start has now been made on the erection of the two circles of steel columns which will be the building's central shaft. The foundations were designed by Moran, Proctor, Freeman and Mueser, New York.

COPPER IN BULGARIA.—A French-controlled concern in Bulgaria is exploiting copper deposits in the region of Panagurischte. The deposits are expected to yield 30,000 tons of ore. The plan was to refine the ore in the works of an affiliated company in Yugoslavia. Under the agreement with the Bulgarian Government the company was to have furnished Bulgaria with 30 per cent. of the output of refined copper, provided the ores contained 6 per cent. copper, and 60 per cent. of the output if the ores contained more than 10 per cent. copper.

BACTERIA BED EXPERIMENTS.—In the annual report for the year 1939–40 of the Birmingham Tame and Rea District Drainage Board, reference is made to experiments being carried out at the Minworth works by the Water Pollution Research Board in conjunction with the Drainage Board. Investigations have, it is said, established, after one year's continuous working, that bacteria beds used in series with a periodic change in their order will purify at least 50 per cent. more sewage per cubic yard of medium than similar beds working singly. There is reason to believe that even better results may be obtained in the future.

TANTALUM ALLOYS.—A Canadian metallurgist, after due research, has suggested the wider use of tantalum in ferrous alloys. Among those produced mention was made of tantalum-iron, tungsten-tantalum and tungsten-molybdenum. Ferro-tantalum (70 per cent. tantalum), to which some niobium had been added, had been used to a certain degree in steel manufacture as an alloy designed to confer hardness. While it increased the elastic limit and breaking strength of the steel, it had no advantage as a cutting alloy tool steel over the tungsten high-speed steels and cost more. It was known as a corrosion-resisting metal when alloyed with iron, but that use for it had not been developed because of the lower cost and greater applicability of the rustless irons and steels.

LEAD SHEATHING CABLE.—The research laboratory of the General Electric Company at Schenectady has devised what is described as a nozzle-swirl process of lead sheathing insulated cable, whereby the prevention and elimination of all oxidation impurities and the production of a sheath of uniform quality and thickness throughout the length of the cable. Essential factors in obtaining these results are the avoidance of exposure of the hot lead to air throughout the process and the development of methods of mechanically removing oxide formations from the lead during the charging of the cylinder of the lead press.

Personal and Business

MR. H. A. J. SILLEY has been appointed chairman and managing director of R. and H. Green and Silley, Weir, Ltd., in succession to his father, the late Mr. J. H. Silley.

MR. JOHN PASCOE, deputy chairman of British Timken, Ltd., Birmingham, has been appointed deputy chairman of Fischer Bearings Company, Ltd., Wolverhampton.

MOTOR TRANSPORT MAINTENANCE ADVISORY COMMITTEE.—Mr. Benjamin King, chairman of Chrysler Motors, Ltd., and of Dodge Brothers (Britain), Ltd., has accepted an invitation to represent vehicle importers on the Motor Transport Maintenance Advisory Committee which has been set up by the Minister of Transport and the Minister of Supply.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Bradford Engineering Society

Monday, March 10th.—Technical College, Bradford. "The Hydraulic Operation of Machine Tools," H. C. Town. 7.15 p.m.

Chemical Engineering Group

Tuesday, March 11th.—Chemical Society's Rooms, Burlington House, Piccadilly, W.1. "Ventilation (Natural and Artificial) in relation to the Black-out," E. W. Murray. 2.30 p.m.

Institute of Marine Engineers

Friday, March 14th.—Connaught Rooms, Great Queen Street, Kingsway, W.C.2. Annual general meeting. 12 noon. Luncheon, 1 for 1.15 p.m.

Institute of Transport

Saturday, March 8th.—METROPOLITAN GRADUATES: Inst. of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. "A Brief Survey of the Creation and Evolution of Occupations and a Consideration of Transport as a Profession," C. F. King. 2.15 p.m.

Monday, March 10th.—Inst. of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. "The Road and Rail Transport Problem," Brigadier-General Sir H. Osborne Mance. 4.50 p.m.

Institute of Welding

Monday, March 3rd.—SCOTTISH BRANCH: Inst. of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow. "What Have We to Fear in Welding?" W. Heigh. 7 p.m.

Institution of Electrical Engineers

Saturday, March 1st.—N. MIDLAND STUDENTS: Hotel Metropole, Leeds. "A.C. Distribution of Underground Cables," H. K. Briggs. 2.30 p.m.

Wednesday, March 12th.—N.E. CENTRE: Literary and Philosophical Society, Westgate Road, Newcastle-upon-Tyne. "Electric Traction," C. E. Fairburn. 6.15 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tuesday, March 11th.—39, Elmbank Crescent, Glasgow, C.2. "Wartime Building," R. Fitzmaurice. 6.30 p.m.

Institution of Mechanical Engineers

Monday, March 3rd.—N.E. BRANCH: Neville Hall, Newcastle-upon-Tyne. "Progress in Marine Engineering as Influenced by the Classification of Ships," S. F. Dorey. 6 p.m.

Wednesday, March 5th.—N.W. BRANCH: City Technica College, Byrom Street, Liverpool. "Progress in Marine Engineering as Influenced by the Classification of Ships," S. F. Dorey. 1.45 p.m.

Institution of Production Engineers

To-day, February 28th.—Institution of Mechanical Engineers, Storey's Gate, S.W.1. "The Efficient Utilisation and Training of Labour under War Conditions," B. C. Jenkins. 2.15 p.m.

Institution of Structural Engineers

Saturday, March 1st.—YORKSHIRE BRANCH: Hotel Metropole, Leeds. "Some Experiences in Construction with special reference to Floors," Sir E. Airey. 2.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, February 28th.—Mining Institute, Neville Hall, Newcastle-upon-Tyne. "Preliminary Calculations in Ship Design," E. E. Bustard. 6 p.m.

Wednesday, March 12th.—STUDENT SECTION: Bolbec Hall, Newcastle-upon-Tyne. "Propeller Design," E. Panagopoulos. 6.45 p.m.

Friday, March 14th.—Mining Inst., Newcastle-upon-Tyne. "Some General Observations on Vibration," J. Calderwood. 6 p.m.

Royal Society of Arts

Tuesday, March 4th.—John Adam Street, Adelphi, W.C.2. "Empire Primary Products in relation to Post-war Reconstruction," F. L. McDougall. 1.45 p.m.

Wednesday, March 12th.—John Adam Street, Adelphi, W.C.2. "Replanning London," W. H. Ansell. 1.45 p.m.

Sheffield Metallurgical Association

Saturday, March 15th.—198, West Street, Sheffield. "Modern Methods of Metallurgical Analysis," E. J. Vaughan. 3 p.m.